ATTACHMENT G: HIGH INTENSITY SOIL SURVEYS AND GEOTECHNICAL REPORTS

Exhibit G-1: Merrill Road Converter Station Class B High Intensity Soils Survey and Geotechnical Report

Exhibit G-2: Fickett Road Substation Class B High Intensity Soils Survey and Geotechnical Report

Exhibit G-3: West Forks and Moxie Gore Termination Stations Class B High Intensity Soils Surveys and Geotechnical Report

Exhibit G-4: HDD Geotechnical Feasibility Memo

Exhibit G-1: Merrill Road Converter Station Class B High Intensity Soils Survey and Geotechnical Report

Class B High Intensity Soil Survey

For

Central Maine Power Company Proposed Converter Site

Perron Lot , Merrill road
Lewiston, ME

Soil Survey completed by Robert Vile Soil Consulting Inc

June 19, 2017

Robert Vile
Licensed Site Evaluator
Certified Soil Scientist

P.O. Box 114, Cates Rd.
Dixmont, ME 04932

Telephone:
(207)234-2451

Date: June 19, 2017

To: Sackett & Brake Survey, Inc.
P.O. Box 207
Skowhegan, Me. 04976

Re: Class B High Intensity Soil Survey of a +- 10 acre parcel of land located off the Merrill Rd in Lewiston,Me. N/F Perron ; for a Central Maine Power Company Proposed Converter Site.

Findings: On June 2.and June 14, 2014 I investigated the above captioned parcel. The purpose of the investigation was to conduct a Class B High Intensity Soil of the property. Soils were described by backhoe excavated test pits to a depth of four feet or ledge refusal and many soil auger borings throughout the parcel. The soil test pit locations as well as a two foot contour map at a scale of 1"=50' were provided by Sackett & Brake Survey, Inc. This soil survey was conducted for the use in the planning of a Central Maine Power Company Converter Site. This Class B High Intensity Soil Survey was mapped following these minimum standards described in Guidelines For Maine Certified Soil Scientists For Soil Identification And Mapping:
Class B (High Inttensity)

1. Map units will not contain dissimilar limiting individual inclusions larger than one acre. Dissimilar limiting inclusions may total more than one acre per map unit delineation, in the aggregate, if not continuous.
2. Scale of 1 inch equals 200 feet or larger.
3. Ground control-test pits for which detailed data is recorded are located by means of compass by chaining , pacing, or taping from known survey points; or other methods of equal or greater accuracy.
4. Base map with 5-foot contour lines.

This parcel is bedrock controlled. Four different Soil Series were identified on the parcel. Peru, Tunbridge, Lyman and Brayton soil series.

The Peru soils are classified as Coarse-loamy, isotic, frigid Aquic Hapllorthods by Soil Taxonomy. These soils are moderately well drained soils that formed in lodgment till on the upland portions of this parcel. Peru soils are deeper than 48" to bedrock These soils exist in hardwood forested uplands on this property with slopes ranging from 3 to 10%. Firm basil till was found between 30 to 36 inches below the mineral surface. Seasonal water table depths were found 27 to 30 inches below the surface . A typical pedon for this series is described at Test Pit # 2. Please see attached test pit logs. Peru soils are a Class C Hydrologic Soil Group. Surface run-off is medium and permeability is moderate in the upper horizons and moderately slow in the lower horizons. There is no hazard to flooding in the areas mapped Peru on this parcel. Inclusions within the mapping units may include the Tunbridge Soil Series which will have bedrock between 20 to 48 inches. Also Lyman soils may be inclusions within the soil units mapped where ledge may be near the surface. The Peru soils will have a very little negative impact on the proposed development of a converter site.

The Tunbridge soils are classified Coarse-loamy, isotic, frigid Typic Haplorthods by Soil Taxonomy.These soils are moderately deep, well drained soils formed in supraglacial till on the forested upland portions of this parcel. Tunbridge soils have bedrock between 20" to 40" on this site. They exist on slopes ranging from 4 to 30% on this parcel. No restrictive layers or seasonal water table was observed in these soils. A typical pedon for this series is described at Test Pit # 1. Please see attached test pit logs. Tunbridge soils are a Class C Hydrologic Soil Group. Surface run-off is medium and permeability is moderately high or high throughout the profile. There is no hazard of flooding on these soils. Inclusions within the Tunbridge mapping unit include the Lyman series and the Peru soil series. The limiting factor of the Tunbridge soils for this project will be the depth to ledge. Blasting may be required .

The Lyman soils are classified Loamy, isotic, frigid Lithic Haplorthods by Soil Taxonomy. These soils are somewhat excessively drained , shallow to bedrock and formed in loamy supraglacial till. They occur on the forested upland portions of the parcel. These soils have bedrock between 6 to 19" on this parcel as well as several bedrock outcrops. There is no seasonal water table associated with these soils. They exist on slopes ranging from 3 to 30 % on this site. A typical pedon for this series is described at Test Pit # 4. Please see attached test pit logs. Lyman soils are a Class C/D Hydrologic Soil Group. Surface run-off is very high to high within these map units. Permeability is moderately high to high in the Lyman soils. There is no hazard of flooding with this series. Inclusions within the Lyman map units include the Tunbridge series where bedrock is found 20" or deeper below the mineral surface. The limiting factor of the Lyman soils for this project is depth to bedrock as blasting may be required.

The Brayton soils are classified Loamy, mixed, active, nonacid, frigid, shallow Aeric Endoaquepts by Soil Taxonomy. These soils are deep , poorly drained glacial till found in the lowland depressions on this parcel. Brayton soils are hydric soils and occur within the wetland areas on this parcel. A detailed wetland delineation was previously done by another scientist on this parcel. Seasonal water tables are at the mineral surface and ponding was observed in these wetland areas. Brayton soils occur on 0-3% slopes on this parcel. A typical pedon for this series is described at Test Pit # 12. Please see attached test pit logs. Brayton soils are a Class C Hydrologic Soil Group. Surface run-off is slow to none on this parcel. The areas mapped Brayton have a flooding hazard as ponded water was evident. Inclusions within the Brayton map units may be the somewhat poorly drained Colonel Soil Series and the very poorly drained Peachem Soil Series. The limiting factor of the Brayton soils for this project is the high water table and they are found in the forested wetland areas.

The accompanying soil profile descriptions , soil survey map and this soil narrative report dated June 19, 2017were done in accordance with the standards adopted by the Maine

Association of Professional Soil Scientists and presented in the " Guidelines for Maine Certified Soil Scientists for Soil Identification and Mapping " latest revision and prepared by Robert G Vile jr. " Certified Soil Scientist # 201.
If you have any questions regarding the investigation or the soil survey please feel free to contact me at the above number.

Sincerely,

STATE OF MAINE
Robert Vile
C.S.S. #201
CERTIFIED
SOIL SCIENTIST

Robert G. Vile jr.
C.S.S. # 201
L.S.E. S204

FORM F 1/01

SOIL PROFILE / CLASSIFICATION INFORMATION

DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES

Project Name: Perron Lot - Converter Site

Applicant Name: Central Maine Power Co.

Project Location (municipality): Merrill Rd. Lewiston

Exploration Symbol: TP#1 ■ Test Pit □ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–27	Fine Sandy Loam	Friable	Dark Brown / Strong Brown / Yellowish Brown	None
27	27" Bedrock			

Soil data by S.E.	Soil Profile: 2	Classification Condition: AIII	Slope Percent: 5	Limiting Factor Depth: 27	□ Groundwater □ Restrictive Layer ■ Bedrock
Soil data by S.S.	Soil series/phase name: Tunbridge		□ Hydric ■ Non-hydric	Hydrologic Soil Group: C	

Exploration Symbol: TP#2 ■ Test Pit □ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–24	Fine Sandy Loam	Friable	Dark Brown / Strong Brown / Yellowish Brown	None
24–28	Sandy Loam		Light	
28–36	Gravelly Loamy Sand	Firm	Olive Brown	Common Distinct

Soil data by S.E.	Soil Profile: 3	Classification Condition: C	Slope Percent:	Limiting Factor Depth: 28	■ Groundwater □ Restrictive Layer □ Bedrock
Soil data by S.S.	Soil series/phase name: Peru		□ Hydric ■ Non-hydric	Hydrologic Soil Group: C	

Exploration Symbol: T.P.#3 ■ Test Pit □ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–20	Fine Sandy Loam	Friable	Dark Brown / Strong Brown / Yellowish Brown	None
20	20" Bedrock			

Soil data by S.E.	Soil Profile: 2	Classification Condition: AIII	Slope Percent:	Limiting Factor Depth: 20	□ Groundwater □ Restrictive Layer ■ Bedrock
Soil data by S.S.	Soil series/phase name: Tunbridge		□ Hydric ■ Non-hydric	Hydrologic Soil Group: C	

Exploration Symbol: TP#4 ■ Test Pit □ Boring

____ " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–6	Fine Sandy Loam	Friable	Reddish Grey Brown	None
6	6" Bedrock			

Soil data by S.E.	Soil Profile: 2	Classification Condition: AI	Slope Percent:	Limiting Factor Depth: 6	□ Groundwater □ Restrictive Layer ■ Bedrock
Soil data by S.S.	Soil series/phase name: Lyman		□ Hydric ■ Non-hydric	Hydrologic Soil Group:	

INVESTIGATOR INFORMATION AND SIGNATURE

Signature: Robert G Vile

Date: 6-17-17

Name Printed/typed: Robert G. Vile jr.

Cert/Lic/Reg. # 201

Title: ■ Licensed Site Evaluator □ Certified Geologist ■ Certified Soil Scientist □ Other:

STATE OF MAINE
Robert Vile
C.S.S. #201
CERTIFIED SOIL SCIENTIST

affix professional seal

FORM F 1/01

SOIL PROFILE / CLASSIFICATION INFORMATION

DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES

Project Name: Perron Lot - Converter Site

Applicant Name: Central Maine Power Co.

Project Location (municipality): Merrill Rd. Lewiston

Exploration Symbol: T.P.#5 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–24	Fine Sandy Loam	Friable	Dark Brown / Strong Brown / Yellowish Brown	None
24–30	Gravely Sandy Loam			
30–48	Gravely Loamy Sand	Firm	Light Olive Brown	Common Distinct

soil data by S.E.	Soil Profile: 3	Classification Condition: C	Slope Percent: ____	Limiting Factor Depth: 27	■ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: Peru		☐ Hydric ■ Non-hydric		Hydrologic Soil Group: C

Exploration Symbol: T.P.#6 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–30	Fine Sandy Loam	Friable	Dark Brown / Strong Brown / Yellowish Brown	None
30–48	Gravely Sandy Loam	Firm	Light Olive Brown	Common Distinct

soil data by S.E.	Soil Profile: 3	Classification Condition: C	Slope Percent: ____	Limiting Factor Depth: 28"	■ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: Peru		☐ Hydric ■ Non-hydric		Hydrologic Soil Group: C

Exploration Symbol: T.P.#7 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–24	Fine Sandy Loam	Friable	Dark Brown / Strong Brown / Yellowish Brown	None
24–48	24" Bedrock			

soil data by S.E.	Soil Profile: 2	Classification Condition: AIII	Slope Percent: ____	Limiting Factor Depth: 24	☐ Groundwater ☐ Restrictive Layer ■ Bedrock
soil data by S.S.	Soil series/phase name: Tunbridge		☐ Hydric ■ Non-hydric		Hydrologic Soil Group: C

Exploration Symbol: T.P.#8 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–24	Fine Sandy Loam	Friable	Dark Yellowish Brown / Strong Brown / Yellowish Brown	None
24–48	24" Bedrock			

soil data by S.E.	Soil Profile: 2	Classification Condition: AIII	Slope Percent: ____	Limiting Factor Depth: 24	☐ Groundwater ☐ Restrictive Layer ■ Bedrock
soil data by S.S.	Soil series/phase name: Tunbridge		☐ Hydric ■ Non-hydric		Hydrologic Soil Group: C

INVESTIGATOR INFORMATION AND SIGNATURE

Signature: Robert G. Vile jr.

Date: 6-17-17

Name Printed/typed: Robert G. Vile jr.

Cert/Lic/Reg. # 201

Title: ■ Licensed Site Evaluator ☐ Certified Geologist ■ Certified Soil Scientist ☐ Other:

STATE OF MAINE
Robert Vile
C.S.S. #201
CERTIFIED SOIL SCIENTIST

FORM F 1/01

SOIL PROFILE / CLASSIFICATION INFORMATION

DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES

Project Name: Perron Lot - Converter Site

Applicant Name: Central Maine Power Co.

Project Location (municipality): Merrill Rd. Lewiston

Exploration Symbol: TP#9 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–6	Fine Sandy Loam	Friable	Dark Brown	
6–22			Strong Brown	None
	Bedrock		4" – 22"	

soil data by S.E.: Soil 2 Profile; Classification AI Condition; Slope ____ Percent; Limiting Factor 4 Depth; ☐ Groundwater ☐ Restrictive Layer ■ Bedrock

soil data by S.S.: Soil series/phase name: Lyman; ☐ Hydric ■ Non-hydric; Hydrologic Soil Group C/D

Exploration Symbol: TP#10 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–7			Dark Yellowish Brown	
7–26	Fine Sandy Loam	Friable	Strong Brown	None
26–40	Very Gravelly Loamy Sand		Yellowish Brown	
40	40" Refusal			

soil data by S.E.: Soil 2 Profile; Classification AIII Condition; Slope ____ Percent; Limiting Factor 40 Depth; ☐ Groundwater ☐ Restrictive Layer ■ Bedrock

soil data by S.S.: Soil series/phase name: Tunbridge; ☐ Hydric ■ Non-hydric; Hydrologic Soil Group C

Exploration Symbol: TP#11 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–6	Fine Sandy Loam	Friable	Dark Brown	None
6–22			Strong Brown	
22–31			Yellowish Brown	
31–44	Gravelly Sandy Loam	Firm	Light Olive Brown	Common Faint

soil data by S.E.: Soil 3 Profile; Classification C Condition; Slope ____ Percent; Limiting Factor 30 Depth; ■ Groundwater ■ Restrictive Layer ☐ Bedrock

soil data by S.S.: Soil series/phase name: Peru; ☐ Hydric ■ Non-hydric; Hydrologic Soil Group C

Exploration Symbol: TB#12 ☐ Test Pit ■ Boring

5 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–12	Fine Sandy Loam	Friable	Very Dark Grey	Common Faint
12–19			Greyish Brown	Common Distinct
19–31		Firm	Olive	Many Prominent

soil data by S.E.: Soil 3 Profile; Classification E Condition; Slope ____ Percent; Limiting Factor 0 Depth; ■ Groundwater ☐ Restrictive Layer ☐ Bedrock

soil data by S.S.: Soil series/phase name: Brayton; ■ Hydric ☐ Non-hydric; Hydrologic Soil Group ____

INVESTIGATOR INFORMATION AND SIGNATURE

Signature: Robert G Vile Jr

Date: 6-17-17

Name Printed/typed: Robert G. Vile Jr.

Cert/Lic/Reg. # 201

Title: ■ Licensed Site Evaluator ☐ Certified Geologist ■ Certified Soil Scientist ☐ Other:

STATE OF MAINE — Robert Vile C.S.S. #201 — CERTIFIED SOIL SCIENTIST

affix professional seal

LOCATION PERU NH+MA ME NY VT

Established Series
Rev. HRM-RFL-DHZ
06/2016

PERU SERIES

The Peru series consists of moderately well drained soils that formed in loamy lodgment till on hills and mountains in glaciated uplands. They are moderately deep to a dense substratum and very deep to bedrock. Estimated saturated hydraulic conductivity is moderately high or high in the solum, and moderately low or moderately high in the dense substratum. Slope ranges from 0 to 60 percent. Mean annual precipitation is about 1180 mm, and mean annual temperature is about 6 degrees C.

TAXONOMIC CLASS: Coarse-loamy, isotic, frigid Aquic Haplorthods

TYPICAL PEDON: Peru fine sandy loam, on a north facing, 15 percent slope in a very stony wooded area. (Colors are for moist soil unless otherwise noted.)

Oe--0 to 3 cm; black (10YR 2/1) moderately decomposed plant material; very friable; very strongly acid (pH 4.9); abrupt smooth boundary. (O horizon thickness is 0 to 10 cm.)

A--3 to 13 cm; dark brown (7.5YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many very fine and fine and few coarse roots; 5 percent rock fragments; very strongly acid (pH 4.8); abrupt wavy boundary. (0 to 10 cm thick)

E--13 to 15 cm; light brownish gray (10YR 6/2) fine sandy loam; weak medium granular structure; friable; common fine roots; 5 percent rock fragments; very strongly acid (pH 4.8); abrupt broken boundary. (0 to 10 cm thick)

Bs1--15 to 18 cm; dark brown (7.5YR 3/4) fine sandy loam; weak fine granular structure; friable; common fine and few coarse roots; 5 percent rock fragments; very strongly acid (pH 5.0); abrupt broken boundary.

Bs2--18 to 33 cm; strong brown (7.5YR 4/6) fine sandy loam; weak fine granular structure; friable; common fine and few coarse roots; 5 percent rock fragments; very strongly acid (pH 5.0); clear wavy boundary.

Bs3--33 to 46 cm; dark yellowish brown (10YR 4/6) fine sandy loam; weak medium subangular blocky structure; friable; common fine roots; 5 percent rock fragments; strongly acid (pH 5.2); abrupt wavy boundary. (Combined thickness of the Bs horizon is 7 to 38 cm).

BC--46 to 54 cm; dark yellowish brown (10YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; few fine roots; common fine faint olive brown (2.5Y 4/3) iron depletions in the matrix; 5 percent rock

fragments; strongly acid (pH 5.2); abrupt smooth boundary. (0 to 38 cm thick)

Cd1--54 to 94 cm: olive brown (2.5Y 4/3) fine sandy loam; 85 percent moderate medium plates and 15 percent sandy lenses; firm; common medium faint olive gray (5Y 4/2) iron depletions in the matrix; 5 percent rock fragments; strongly acid (pH 5.2); clear wavy boundary.

Cd2--94 to 165 cm; olive gray (5Y 4/2) fine sandy loam; 95 percent moderate thick plates and 5 percent sandy lenses; firm; common medium faint olive brown (2.5Y 4/3) masses of iron accumulation on faces of peds; 5 percent rock fragments; strongly acid (pH 5.2).

TYPE LOCATION: Merrimack County, New Hampshire; Town of New London; located about 275 meters west of County Road on Northwood Lane, and 35 meters south of the road; USGS Sunapee Lake North, NH topographic quadrangle; latitude 43 degrees 24 minutes 04 seconds N. and longitude 72 degrees 01 minutes 17 seconds W., NAD 83.

RANGE IN CHARACTERISTICS: The thickness of the mineral solum and depth to densic materials from the mineral surface range from 50 to 100 cm. Depth to bedrock is greater than 150 cm. Texture is typically fine sandy loam, sandy loam, or loam in the fine-earth fraction but includes silt loam and very fine sandy loam in the upper part of the solum. The weighted average of clay in the particle-size control section is 10 percent or less. The silt content in the solum and underlying till averages less than 50 percent, but ranges to 50 percent or more in the upper 25 cm of the solum. Rock fragments are dominantly gravel with some cobbles and stones and typically range from 5 to 30 percent throughout the mineral soil. Some pedons have horizons with less than 5 percent rock fragments. Reaction ranges from extremely acid to slightly acid in the solum, and from very strongly acid to slightly acid in the substratum.

The O horizons, where present, consist of slightly, moderately, and/or highly decomposed organic material. The Oe and Oa horizons have hue of 2.5YR to 10YR, value of 2 to 4, and chroma of 1 to 4.

The A, or Ap horizon where present, has hue of 5YR to 10YR and value and chroma of 2 to 4.

The E horizon is neutral or has hue of 5YR to 2.5Y, value of 4 to 7, and chroma of 0 to 2.

The Bhs horizon, where present, is up to 13 cm thick and has hue of 2.5YR to 10YR, a value of 2 to 3, and a chroma of 1 to 3.

The Bs horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 3 to 8.

The BC horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 2 to 6.

Some pedons have an E or E' horizon below the B horizon. It has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 or 3. Typically, it has a coarser texture than the overlying horizon.

Some pedons have a friable C horizon up to 20 cm thick that has color and texture similar to the underlying Cd horizon.

The Cd horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 2 to 4. Consistence is firm or very firm. Arrangement of soil particles into plates is considered to be geogenic. Loose or fri ble segregated sand lenses with a horizontal orientation compose up to 20 percent of the densic materials. The lenses are typically coarse, medium, or fine sand ranging from 2 to 25 mm thick.

COMPETING SERIES: These are the Chesuncook, Crary, Dixmont, Howland, Ragmuff, Skerry, Sunapee, and Worden series. Chesuncook soils have a weighted average of more than 10 percent clay in the particle-size control section. Crary soils have a mantle of eolian or water deposited sediments ranging from 40 to 100 cm thick over till. Dixmont and Sunapee soils are formed in loamy supraglacial till and do not have densic materials within 100 cm of the mineral soil surface. Howland soils have a weighted average of more than 50 percent silt in the particle-size control section. Ragmuff soils are moderately deep to bedrock. Skerry soils have more than 20% sandy lenses in the Cd horizon. Worden soils are somewhat poorly drained.

GEOGRAPHIC SETTING: Peru soils are on nearly level to steep slopes in glaciated uplands. Typically they are on linear or convex areas of backslopes, footslopes, and toeslopes, but they also occur in concave positions. The soils formed in loamy lodgment till derived mainly from schist, gneiss, phyllite, and granite. Slope ranges from 0 to 60 percent. The mean annual precipitation is 790 to 1640 mm, and the mean annual temperature is 2 to 7 degrees C. The frost-free period ranges from 90 to 160 days. Elevation ranges from about 2 to 800 meters above sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Berkshire, Brayton, Cabot, Colonel, Lyman, Marlow, Monadnock, Peacham, Pillsbury, Sunapee, and Tunbridge soils. Berkshire, Lyman, Monadnock, Sunapee, and Tunbridge soils are formed in supraglacial till and do not have densic materials. Additionally, Lyman soils are shallow to bedrockk, and Tunbridge soils are moderately deep to bedrock. Peru soils are in a drainage sequence with the well drained Marlow soils, somewhat poorly drained Colonel soils, poorly drained Brayton, Cabot, and Pillsbury soils, and very poorly drained Peacham soils.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Moderately well drained. Estimated saturated hydraulic conductivity is moderately high or high in the solum, and moderately low or moderately high in the dense substratum.

USE AND VEGETATION: Most areas are wooded. The common trees are sugar maple, eastern white pine, balsam fir, red spruce, white spruce, white ash, yellow birch, paper birch, eastern hemlock, American beech, and red pine. Areas cleared of stones are used mainly for hay and pasture and some cultivated crops.

DISTRIBUTION AND EXTENT: Maine, Massachusetts, New Hampshire, New York, and Vermont. The soils of this series are extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Berkshire County, Massachusetts, 1923.

REMARKS: 1. Dixfield soils were recorrelated to Peru soils as part of the national Soil Data Join Recorrelation initiative. Revisions to the Peru Range in Characteristics incorporate values from the Dixfield Official Series Description. As a result of this revision to Peru, the Dixfield series status has been changed to

inactive.

2. Diagnostic horizons and features recognized in this pedon are:

a. Ochric epipedon - the zone from 0 to 15 cm (Oe, A, and E horizons).
b. Spodic horizon - the zone from 15 to 33 cm (Bs1 and Bs2 horizons).
c. Aquic conditions - redoximorphic features at 43 cm below the mineral soil surface (BC, Cd1, and Cd2 horizons).
d. Densic materials - the zone from 54 to 165 cm (Cd1 and Cd2 horizons).

ADDITIONAL DATA: Characterization data for Peru and similar soils is available through the National Cooperative Soil Survey Soil Characterization Database: http://ncsslabdatamart.sc.egov.usda.gov/

National Cooperative Soil Survey
U.S.A.

LOCATION TUNBRIDGE VT+MA ME NH NY

Established Series
Rev. RLM-SHG-RFL
01/2016

TUNBRIDGE SERIES

The Tunbridge series consists of moderately deep, well drained soils on glaciated uplands. They formed in loamy supraglacial till. Saturated hydraulic conductivity is moderately high or high throughout the mineral soil. Slope ranges from 0 to 80 percent. Mean annual precipitation is about 1180 mm, and mean annual temperature is about 6 degrees C.

TAXONOMIC CLASS: Coarse-loamy, isotic, frigid Typic Haplorthods

TYPICAL PEDON: Tunbridge fine sandy loam, on a west-facing, 58 percent slope under mixed northern hardwoods. (Colors are for moist soil.)

Oe--0 to 8 cm; black (7.5YR 2.5/1) moderately decomposed plant material; many very fine and fine roots; clear wavy boundary.

Oa--8 to 13 cm; black (10YR 2/1) highly decomposed plant material; many very fine and fine and common medium roots; abrupt wavy boundary. (Combined thickness of the O horizons is 0 to 15 cm.)

E--13 to 20 cm; dark gray (10YR 4/1) fine sandy loam; weak fine subangular blocky structure; friable; common fine and medium roots; 5 percent gravel and 5 percent cobbles; very strongly acid (pH 4.8); abrupt wavy boundary. (0 to 20 cm thick)

Bhs--20 to 28 cm; dark reddish brown (5YR 2.5/2) fine sandy loam; weak fine subangular blocky structure; friable; common fine and medium roots; 10 percent gravel and 2 percent cobbles; very strongly acid (pH 4.8); gradual wavy boundary.

Bs--28 to 66 cm; dark reddish brown (5YR 3/3) and reddish brown (5YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; common fine, many medium, and common coarse roots; 10 percent gravel and 3 percent cobbles; strongly acid (pH 5.2); abrupt smooth boundary. (Combined thickness of the Bhs and Bs horizons is 10 to 60 cm.)

BC--66 to 71 cm; dark yellowish brown (10YR 3/4) fine sandy loam; weak fine subangular blocky structure; friable; few medium roots; 5 percent gravel; strongly acid (pH 5.4); abrupt wavy boundary. (0 to 40 cm thick)

R--71 cm; granite bedrock.

to bedrock ranges from 50 to 100 cm. Reaction ranges from extremely acid to moderately acid in the solum and from strongly acid to slightly acid in the substratum. Rock fragments range from 5 to 35 percent throughout the mineral soil. They are mostly gravel, channers, and cobbles, but the range includes stones. The weighted average of clay in the particle-size control section is 1 to 10 percent. The silt content in the solum and substratum is typically less than 50 percent. Stony and bouldery phases of the Tunbridge series are recognized.

The O horizons, where present, consist of slightly, intermediately, and/or highly decomposed plant material.

Some pedons have an A or Ap horizon that is neutral or has hue of 5YR to 10YR, value of 2 to 5, and chroma of 0 to 4. It is typically loam, very fine sandy loam, fine sandy loam, or sandy loam in the fine-earth fraction, but the range includes silt loam. It is up to 15 cm thick.

The E horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 1 or 2. It is typically loam, very fine sandy loam, fine sandy loam, sandy loam, loamy fine sand, or loamy sand in the fine-earth fraction, but the range includes silt loam.

Some pedons have a BE horizon that has hue of 5YR to 10YR, value of 4 to 6, and chroma of 2 to 4. Textures are similar to the E horizon.

The Bhs horizon has hue of 5YR to 10YR, with value and chroma of 3 or less.

The Bs horizon has hue of 5YR to 2.5Y, value of 3 or more and chroma of 4 or more.

The BC horizon has hue of 7.5YR to 2.5Y, value of 3 to 5, and chroma of 3 to 8.

The B horizons are typically loam, very fine sandy loam, fine sandy loam, or sandy loam in the fine-earth fraction, but the range includes silt loam. Some BC horizons have a texture of loamy sand.

Some pedons have a C horizon that has hue of 10YR to 5Y, value of 3 to 6, and chroma of 2 to 6. It is typically loam, very fine sandy loam, fine sandy loam, or sandy loam in the fine-earth fraction, but the range includes silt loam and loamy sand. It is up to 45 cm thick.

Bedrock is slightly weathered schist, gneiss, phyllite, granite, or meta-anorthosite.

COMPETING SERIES: These are the Bangor, Berkshire, Dekapen, Elliottsville, Groveton, Houghtonville, Penquis, Potsdam, Revel, and Welcome series. Bangor, Berkshire, Dekapen, Groveton, Houghtonville, Potsdam, and Welcome soils have a depth to bedrock greater than 100 cm below the mineral soil surface. Elliottsville soils have a weighted average of more than 10 percent clay in the particle-size control section. Revel soils have a paralithic contact between 50 and 100 cm and average 35 to 65 percent weathered gravel in the particle-size control section. Penquis soils contain pararock fragments of calcareous metasiltstone and metasandstone, or metalimestone throughout the soil.

GEOGRAPHIC SETTING: Tunbridge soils are on nearly level to very steep glaciated uplands. They are on the tops and sides of hills and mountains. Slope ranges from 0 to 80 percent. The soils formed in loamy supraglacial till of Wisconsin age derived mainly from micaceous schist, gneiss, phyllite, granite, and meta-anorthosite. The mean annual precipitation is 790 to 2420 mm, and the mean annual temperature is -3 to 7 degrees C. The frost-free period is from 60 to 160 days. Elevation ranges from about 2 to 800 meters above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Becket, Berkshire, Colonel, Lyman, Rawsonville, Marlow, Peru, and Sunapee soils. The very deep to bedrock Becket, Berkshire, Colonel, Marlow, Peru, and Sunapee soils are typically on footslopes and backslopes in lower positions than nearby Tunbridge soils. Additionally, Becket, Colonel, Marlow, and Peru soils formed in loamy lodgment till. Rawsonville soils are in positions similar to Tunbridge soils and have 6 percent or more organic carbon in a layer 10 cm or more thick within the spodic horizon. Tunbridge soils are often closely intermingled with shallow Lyman soils in places where local relief is controlled by the underlying bedrock.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Well drained. Saturated hydraulic conductivity is moderately high or high throughout the mineral soil.

USE AND VEGETATION: Most areas are wooded. The common trees are American beech, white ash, yellow birch, paper birch, northern red oak, sugar maple, eastern white pine, eastern hemlock, red spruce, white spruce, and balsam fir. Some areas have been cleared and are primarily used for hay and pasture. A few cleared areas are used for cultivated crops.

DISTRIBUTION AND EXTENT: Vermont, Maine, Massachusetts, New Hampshire, and New York. MLRAs 143, 144A, and 144B. The series is extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Orange County, Vermont, 1975.

REMARKS: 1. Tunbridge is the official State Soil of Vermont.

2. Albic horizons may be difficult to locate because tree throws and other disturbances have destroyed them in many areas of Tunbridge soils. Albic horizons are often thin, may be discontinuous, and located within 10 cm of the soil surface.

3. The use of the Tunbridge series in MLRA 144A is in question. Tunbridge has a frigid temperature regime which is not typical in 144A.

4. The diagnostic horizons and features recognized in this pedon are:
a. Ochric epipedon - the zone from 0 to 20 cm (Oe, Oa, E horizons).
b. Albic horizon - the zone from 13 to 20 cm (E horizon).

c. Spodic horizon - the zone from 20 to 66 cm (Bhs, Bs horizons).

ADDITIONAL DATA: Laboratory characterization data for Tunbridge and similar soils is available through the National Cooperative Soil Survey Soil Characterization Database: http://ncsslabdatamart.sc.egov.usda.gov/

National Cooperative Soil Survey
U.S.A.

LOCATION LYMAN MA+ME NH NY VT

Established Series
Rev. WHT-CAW-RFL-GWS
02/2016

LYMAN SERIES

The Lyman series consists of shallow, somewhat excessively drained soils on glaciated uplands. They formed in loamy supraglacial till. Estimated saturated hydraulic conductivity is moderately high or high throughout the mineral soil. Slope ranges from 0 to 80 percent. Mean annual precipitation is about 1175 mm, and mean annual temperature is about 5 degrees C.

TAXONOMIC CLASS: Loamy, isotic, frigid Lithic Haplorthods

TYPICAL PEDON: Lyman loam, on a northwest facing, 55 percent slope in a very rocky forested area. (Colors are for moist soil.)

Oe --0 to 3 cm; moderately decomposed plant material. (O horizon thickness is 0 to 15 cm.)

A--3 to 8 cm; black (N 2/0) loam; weak fine granular structure; very friable; many fine and medium roots; extremely acid; abrupt wavy boundary. (0 to 10 cm thick)

E--8 to 13 cm; reddish gray (5YR 5/2) fine sandy loam; weak fine granular structure; very friable; many fine and medium roots; 10 percent gravel; extremely acid; abrupt broken boundary. (0 to 25 cm thick)

Bhs--13 to 18 cm; very dusky red (2.5YR 2.5/2) loam; weak fine granular structure; friable; many fine and medium roots; 10 percent fine gravel; extremely acid; abrupt broken boundary.

Bs1--18 to 28 cm; dark red (2.5YR 3/6) loam; weak fine and medium granular structure; friable; many fine and medium roots; 10 percent fine gravel; few mica flakes; very strongly acid; clear wavy boundary.

Bs2--28 to 46 cm; brown (7.5YR 4/4) grading with depth to brown (10YR 5/3) channery loam; weak coarse subangular blocky structure parting to medium and fine granular; friable; many fine and medium roots; 15 percent channers of schist and quartzite; common flakes of mica; very strongly acid; abrupt smooth boundary. (Combined thickness of the Bhs and Bs horizons is 10 to 43 cm.)

R--46 cm; dark gray mica schist bedrock.

TYPE LOCATION: Franklin County, Massachusetts; Town of Monroe; located about 550 meters west southwest of the village of Monroe Bridge and about 55 meters south of the Deerfield River; USGS Rowe, MA topographic quadrangle; lat. 42 degrees 43 minutes 12.53 seconds N. and long. 72 degrees 56 minutes 52.71

seconds W., NAD 83.

RANGE IN CHARACTERISTICS: The thickness of the mineral solum ranges from 25 to 50 cm, and corresponds to the depth to bedrock. The weighted average of clay in the particle-size control section is 1 to 10 percent. Reaction ranges from moderately acid to extremely acid throughout, unless limed. Rock fragments range from 0 to 35 percent throughout the mineral soil. They are mostly gravel and channers, but the range includes cobbles and stones.

Some pedons have Oi, Oe, and/or Oa horizons that consist of slightly, moderately, or highly decomposed organic material, respectively.

The A horizon is neutral or has hue of 5YR to10YR, value of 2, 2.5, or 3, and chroma of 0 t0 2. Some pedons have an Ap horizon with value and chroma of 2 to 4. Ap horizons are typically 15 cm or more thick. The A or Ap horizon is sandy loam, fine sandy loam, very fine sandy loam, loam, or silt loam in the fine-earth fraction.

The E horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 1 or 2. It is loamy sand, loamy fine sand, sandy loam, fine sandy loam, very fine sandy loam, loam, or silt loam in the fine-earth fraction.

The Bhs horizon has hue of 2.5YR to 10YR, with value and chroma of 3 or less.

The Bs horizon has hue of 2.5YR to 10YR, value of 3 to 5, and chroma of 3 to 8.

Some pedons have a BC horizon with hue of 10YR to 5Y, value of 3 to 5, and chroma of 3 or 4. Texture of the B and BC horizons is sandy loam, fine sandy loam, very fine sandy loam, loam or silt loam in the fine-earth fraction. Some pedons have a loamy sand BC horizon.

Bedrock is slightly weathered schist, gneiss, phyllite, or granite.

COMPETING SERIES: These are the [illegible], [illegible], and [illegible] series. Abram soils have bedrock at a depth of less than 25 cm from the mineral soil surface. Creasey soils have sandstone or conglomerate bedrock. Monson soils average more than 10 percent clay in the particle-size control section.

GEOGRAPHIC SETTING: Lyman soils are on nearly level to very steep glaciated uplands. They are on the tops and sides of hills and mountains. Slope ranges from 0 to 80 percent. The soils formed in loamy supraglacial till of Wisconsin age derived mainly from micaceous schist, gneiss, phyllite, and granite. The mean annual precipitation is 790 to 2420 mm, and the mean annual temperature is -3 to 9 degrees C. The frost-free period is from 60 to 160 days. Elevation ranges from about 2 to 800 meters above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [illegible], [illegible], [illegible], Hogback, Marlow, Peru, Skerry, Sunapee, and Tunbridge soils. The very deep to bedrock Becket, Berkshire, Colonel, Marlow, Peru, Skerry, and Sunapee soils are typically on footslopes and backslopes in lower positions than nearby Lyman soils. In addition, Becket, Colonel, Marlow, Peru, and Skerry soils are formed in loamy lodgment till. Hogback soils are in positions similar to Lyman soils and have 6 percent or more organic carbon in a layer 10 cm or more thick within the spodic horizon. Lyman soils are often closely intermingled with the moderately deep Tunbridge soils in places where local relief is controlled by the underlying bedrock.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat excessively drained. Potential runoff is very high. Estimated saturated hydraulic conductivity is moderately high or high in the mineral soil.

USE AND VEGETATION: Most areas are wooded. The common trees are American beech, white ash, yellow birch, paper birch, northern red oak, sugar maple, eastern white pine, eastern hemlock, red spruce, white spruce, and balsam fir. Some areas have been cleared and are primarily used for hay and pasture. A few cleared areas are used for cultivated crops.

DISTRIBUTION AND EXTENT: Northern New England, western Massachusetts, and northern New York. Principally in the Green and White Mountains, the Adirondack Mountains, the Berkshire uplands, and eastern and western Maine. MLRAs 143, 144A, and 144B. The series is extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Grafton County, New Hampshire, 1935.

REMARKS: 1. The use of the Lyman series in MLRA 144A is in question. Lyman has a frigid temperature regime which is not typical in 144A.

2. Diagnostic horizons and features recognized in this pedon are:
a. Ochric epipedon - the zone from 0 to 13 cm (Oe, A, and E horizons).
b. Albic horizon - the zone from 8 to 13 cm (E horizon).
c. Spodic horizon - the zone from 13 to 46 cm (Bhs, Bs1, and Bs2 horizons).
d. Lithic feature - bedrock at 43 cm from the mineral soil surface.

ADDITIONAL DATA: Characterization data for Lyman and similar soils is available through the National Cooperative Soil Survey Soil Characterization Database: http://ncsslabdatamart.sc.egov.usda.gov/

National Cooperative Soil Survey
U.S.A.

LOCATION BRAYTON ME+CT MA NY VT

Established Series
Rev. KJL-DEW-ANA
09/2013

BRAYTON SERIES

The Brayton series consists of very deep, poorly drained soils on toeslopes and depressions of glaciated uplands. These soils formed in dense till. Saturated hydraulic conductivity is moderately high or high in the solum and moderately low or moderately high in the dense substratum. Slope ranges from 0 to 25 percent. Mean annual temperature is about 7 degrees C, and mean annual precipitation is about 1092 mm.

TAXONOMIC CLASS: Loamy, mixed, active, nonacid, frigid, shallow Aeric Endoaquepts

TYPICAL PEDON: Brayton fine sandy loam, in a gently sloping, very stony forested area. (Colors are for moist soil unless otherwise stated.)

Oi--0 to 2 cm; slightly decomposed leaves, needles and twigs.

Oa--2 to 13 cm; black (5YR 2/1) highly decomposed organic material; weak very fine granular structure; very friable, many very fine, fine and medium, and common coarse roots; extremely acid; abrupt wavy boundary. (Combined thickness of the O horizons is 0 to 15 cm.)

A--13 to 18 cm; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 6/1) dry; weak fine and medium granular structure; very friable; many very fine, fine and medium, and common coarse roots; 10 percent rock fragments; extremely acid; abrupt wavy boundary. (0 to 15 cm thick)

Eg--18 to 25 cm; gray (10YR 5/1) gravelly fine sandy loam; few medium distinct pinkish gray (5YR 6/2) masses of iron accumulation and few fine faint gray (10YR 6/1) iron depletions; weak very fine subangular blocky structure; friable; many very fine and fine, and common medium roots; 20 percent rock fragments; extremely acid; abrupt wavy boundary. (0 to 10 cm thick)

Bg--25 to 41 cm; grayish brown (2.5Y 5/2) fine sandy loam; weak very fine and fine subangular blocky structure; friable; common very fine and fine roots; many medium prominent dark yellowish brown (10YR 4/6) masses of iron accumulation and few fine faint gray (10YR 6/1) iron depletions; 10 percent rock fragments; strongly acid; clear wavy boundary. (13 to 51 cm thick)

BC--41 to 58 cm; light olive brown (2.5Y 5/4) fine sandy loam; weak thin platy structure; firm; many medium faint dark yellowish brown (10YR 4/4) masses of iron accumulation and few fine prominent gray (10YR 6/1) iron depletions; 10 percent rock fragments; moderately acid; clear wavy boundary. (0 to 25 cm thick)

Cd1--58 to 74 cm; olive (5Y 5/3) fine sandy loam; moderate thin and medium platy; very firm; many medium prominent yellowish brown (10YR 5/6) and common medium prominent dark yellowish brown masses of iron accumulation, few fine prominent gray (10YR 6/1) iron depletions; 10 percent rock fragments; slightly acid; clear wavy boundary.

Cd2--74 to 165 cm; olive (5Y 4/3) fine sandy loam; massive; very firm; common medium distinct dark yellowish brown (10YR 4/4) masses of iron accumulation, few fine prominent gray (10YR 6/1) iron depletions; 10 percent rock fragments; slightly acid.

TYPE LOCATION: Hancock County, Maine; town of Mariaville; off Maine Route 181, about 1.3 miles north of the bridge spanning the West Branch of Union River, about 500 feet southeast of highway; USGS Amherst topographic quadrangle; lat. 44 degrees 46 minutes 47 seconds N. and long. 68 degrees 22 minutes 15 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: The combined thickness of the A, E, B and BC horizons is 25 to 50 cm. Depth to bedrock from the mineral soil surface is more than 152 cm. Reaction ranges from extremely acid to moderately acid in the A and Eg horizons and from strongly acid to slightly acid in the B and BC horizons. One or more subhorizons in the subsoil below a depth of 25 cm have pH greater than 5.5. The Cd layer ranges from moderately acid to neutral. Rock fragments in the mineral soil range from 5 to 35 percent by volume. The proportions of rock fragments are about 80 percent gravel, 15 percent cobbles, and 5 percent stones. Some pedons have channers and flagstones. Stones and boulders cover from 0 to 25 percent of the surface. Textures of the solum are silt loam, loam, very fine sandy loam, fine sandy loam, or sandy loam in the fine-earth fraction with less than 10 percent clay. The substratum textures are loam, very fine sandy loam, fine sandy loam, or sandy loam in the fine-earth fraction with less than 10 percent clay. Consistence is very friable to firm in the solum and firm or very firm in the dense substratum.

The O horizon, where present, is fibric, hemic and/or sapric material.

The A or Ap horizon, where present, has hue of 10YR to 5Y, value of 2 to 4, and chroma of 1 to 4. Structure is granular.

The Eg horizon, where present, has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 or 2.

The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It has subangular blocky, granular or platy structure.

The BC horizon, where present, has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 to 4. It has subangular blocky or platy structure.

One or more subhorizon in the subsoil has matrix chroma of 2 or less. The combined thickness of the B and BC horizons is at least 6 inches.

The Cd layer has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 to 4. It is prismatic parting to platy, platy or it is massive. Aggregations bounded by planes or zones of weakness are considered inherent in the parent material.

COMPETING SERIES: This is the [illegible] series. Aurelie soils have 18 to 27 percent clay throughout the particle size control section. Monarda and Pillsbury are in closely related families. They have pH less than 5.5 in the subsoil below a depth of 25 cm and Monarda soils have 10 to 18 percent clay in the particle-size control section.

GEOGRAPHIC SETTING: Brayton soils are in depressions and on toeslopes of glaciated uplands. Slopes range from 0 to 25 percent. The soils formed in dense till derived mainly from granite, phyllite, schist, slate, and shale of Wisconsin age. The climate is humid and cool temperate. Mean annual temperature ranges from 3 to 8 degrees C, and mean annual precipitation commonly ranges from 864 to 1219 mm but includes up to 1524 mm in the coastal area of Mt. Desert Island, Maine. The frost-free season ranges from 90 to 160 days. Elevations range from about 2 to 762 m above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Colonel, Dummerston, Dixfield, Fullam, Hubbardton, Lyman, Macomber, Marlow, Peru, Skerry, Taconic, Tunbridge, and Peacham soils. The Colonel, Dixfield, Lyman, Marlow, Peru, Skerry, and Tunbridge soils have spodic horizons, are better drained, and are on higher topographic positions. Peacham soils have a histic epipedon and are in lower topographic positions. The Dummerston, Fullam, Hubbardton, Macomber, and Taconic soils are better drained and are on higher topographic positions.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Poorly drained. A perched water table is above the dense substratum from autumn through spring. Estimated saturated hydraulic conductivity is moderately high or high in the solum and moderately low or moderately high in the dense substratum.

USE AND VEGETATION: Most areas of this soil are forested. Some areas are cleared and used for hay and pasture. Forest vegetation is mainly red spruce, white spruce, black spruce, balsam fir, eastern white pine, red maple, northern white cedar, and paper birch, yellow birch and hemlock.

DISTRIBUTION AND EXTENT: Connecticut, Maine, Massachusetts, New York, and Vermont. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Essex County, New York, 1954.

REMARKS: After reviewing location, geographic coordiantes changed from USGS Amherst topographic quadrangle; lat. 44 degrees 46 minutes 48 seconds N. and long. 68 degrees 22 minutes 19 seconds W., NAD 27.

Diagnostic horizons and features recognized in this pedon include:
1. Ochric epipedon - the zone from 0 to 18 cm (Oi, Oa and A horizons).
2. Cambic horizon - the zone from 25 to 58 cm (Bg and BC horizons).
3. Densic contact - very firm, dense basal till at a depth of 58 cm.
4. Aeric Feature - both value and chroma of 3 or more in the zone from 41 to 58 (BC horizon).
5. Aquic conditions - redox depletions throughout the subsoil. (Eg, Bg and BC horizons).

The Aurelie series is included in the competing soils section with a previous revision.

Previous remarks June, 2004 revision:
The type location is changed with this revision based on consensus that placement in the shallow family is reflective of the dominant characteristics of the series. It is acknowledged that historically the series exceeded 50 cm to densic contact in some places. The series is re-classified from Epiaquepts to Endoaquepts in accordance with Soil Taxonomy which, in reference to applying keys, stipulates that diagnostic horizons and properties below a densic contact are excluded. It is assumed the depth to bedrock from the mineral surface of this pedon exceeds 152 cm. This soil was previously type located in New York and classified as Coarse-loamy, mixed, nonacid, frigid Aeric Fragiaquepts. The classification was changed as a result of the Northeast Fragipan Study. This series also included somewhat poorly drained soils but has since been restricted to poorly drained.

ADDITIONAL DATA: Source of the data used in establishing taxonomic class and range in characteristics is Maine Agricultural Experiment Station Technical Bulletin 94, September 1979.
Soil Interpretation Record Numbers for the Brayton Series are: Brayton, ME0100; Brayton, stony, ME0101; Brayton bouldery, ME0123; Brayton, variant ME0090.

National Cooperative Soil Survey
U.S.A.


ROBERT VILE SOIL CONSULTING, INC.
P.O. BOX 114 DIXMONT, MAINE 04932
CLASS B HIGH INTENSITY SOIL SURVEY
FOR:
CENTRAL MAINE POWER COMPANY
"PERRON PARCEL"
LOCATION: northerly of MERRILL ROAD
LEWISTON, ANDROSCOGGIN COUNTY, MAINE
FIELD SURVEY: ROBERT VILE
CERTIFIED SOIL SCIENTIST #201
JUNE 12, 2017
SCALE 1"=60'
GRAPHIC SCALE
(IN FEET)
1 inch = 60 ft.
LEGEND
= 3/4" IRON REBAR SET WITH RED PLASTIC CAP INSCRIBED S.W. GOULD PLS 2318 (unless otherwise noted).
= INTERMEDIATE CONTOUR (NAVD88 FEET)
= INDEX CONTOUR (NAVD88 FEET)
= WETLAND BOUNDARY
= WETLAND
NOTES
NOTE...1 BOUNDARY SURVEY AND TOPOGRAPHIC INFORMATION PROVIDED BY SACKETT & BRAKE SURVEY, INC.
NOTE...2 WETLAND LOCATION WAS PROVIDED BY CENTRAL MAINE POWER COMPANY
SOILS LEGEND
Br - Brayton Series - Poorly Drained
Pr - Peru Series - Moderatly Well Drained
Tb - Tunbridge Series - Well Drained
Ly - Lyman Series - Somewhat Excessively Drained
Slope Phases
A : 0% TO 3% Slope
B : 3% to 8% Slope
C : 8% to 15% Slope
D : 15% to 25% Slope
E : greater than 25% Slope
: Soil Test Pit
: Soil Boundary
Tb/C
Soil Series
Slope Phase
STATE OF MAINE
Robert Vile
C.S.S. #201
CERTIFIED SOIL SCIENTIST
ROBERT VILE
CSS#201
2017085-SOILS
n/f
RONNIE N. CHAREST
CAROL A.J. CHAREST
6803/214 June 22, 2006
Lewiston Map 136 Lot 3
n/f
GEORGE P. SCHOTT
3580/349 April 12, 1996
Greene Map 2 Lot 55
CENTRAL MAINE POWER COMPANY
3761/304 December 23, 2005
reference 408/280
S 55°08'27" E
32.44'
484.18' Corner - Rebar
Greene
Lewiston
S 55°08'27" E
960.29'
7"x18" granite monument found 42" tall
476.11' Corner - Granite
S 55°08'27" E
27.78'
5/8" iron rebar with survey cap #2259 found 14" tall
N 38°00'54" E
122.41'
N 22°59'06" E
124.90'
Northwesterly line of LOT 79
stream
N 22°59'06" E
929.04'
S 36°46'16" W
976.00'
LOUIS C. PERRON
ROBERTA M. PERRON
portion of
2159/240 September 23, 1987
Lewiston Map 138 Lot 34
20.010 acres
other land of:
LOUIS C. PERRON
ROBERTA M. PERRON
1745/003 July 26, 1984
Lewiston Map 138 Lot 35
Central Maine Power Company
Section 200
Central Maine Power Company
Section 251
#291
#285
#292
#286
#293
#287
#294
50'
vernal pool
745.40'
N 59°26'38" W
CENTRAL MAINE POWER COMPANY
3761/304 December 23, 2005
reference 407/526 November 14, 1930
retained land of:
LOUIS C. PERRON
ROBERTA M. PERRON
2159/240 September 23, 1987
Lewiston Map 138 Lot 34
BrA
PrC
TbC
TbE
LyC
TbD
PrC
BrA
TbD
LyD
PrB
TbE
LyE
TbC
BrA
LyC
TbD
TbB
TbC
TbE
PrB
TbB
PrC
BrA
TbD
TEST PIT #12
TEST PIT #11
TEST PIT #10
TEST PIT #1
TEST PIT #2
TEST PIT #9
TEST PIT #3
TEST PIT #8
TEST PIT #4
TEST PIT #7
TEST PIT #6
TEST PIT #5
300
310
320
330
340
350
360
370
380

REPORT

17-1017 S

May 11, 2018

Explorations and Geotechnical Engineering Services

Proposed Converter Station
Merrill Road
Lewiston, Maine

Prepared For:
Central Maine Power Company
Attention: Gerry Mirabile
83 Edison Drive
Augusta, Maine 04336

Prepared By:
S. W. Cole Engineering, Inc.
286 Portland Road
Gray, Maine 04039
T: 207-657-2866

S.W.COLE
ENGINEERING, INC.

- Geotechnical Engineering
- Construction Materials Testing and Special Inspections
- GeoEnvironmental Services
- Test Boring Explorations

www.swcole.com

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17-1017 S

May 11, 2018

Central Maine Power Company
Attention: Gerry Mirabile
83 Edison Drive
Augusta, Maine 04336

Subject: Explorations and Geotechnical Engineering Services
Proposed Converter Station
Merrill Road
Lewiston, Maine

Dear Gerry:

In accordance with our revised Proposal, dated March 13, 2018, we have performed subsurface explorations for the subject project. This report summarizes our findings and geotechnical recommendations and its contents are subject to the limitations set forth in Appendix A.

1.0 INTRODUCTION

1.1 Scope and Purpose

The purpose of our services was to obtain subsurface information at the site in order to develop preliminary geotechnical recommendations relative to foundations and earthwork associated with the proposed construction. Our scope of services included test boring explorations, soils laboratory testing, a geotechnical analysis of the subsurface findings and preparation of this report.

1.2 Site and Proposed Construction

The proposed converter substation is located north of Merrill Road and east of the existing CMP transmission right-of-way in Lewiston, Maine. Based on an updated plan you provided dated March 6, 2018, we understand the proposed substation yard will be on the order of 580 by 510 feet in plan dimensions. An underdrain soil filter is planned on the westerly side of the substation pad area. We understand the proposed access road to the proposed substation is not yet defined and therefore not included in this scope of services.

Based on topographic information shown on the plan, the wooded site slopes upward from about elevation 305 feet on the westerly side, near the existing transmission right-of-way, to about elevation 380 feet on the easterly side. Bedrock outcrops are visible in the upper elevations of the site (easterly side) and ponded surface water was observed in the lower elevations (northwest corner) during drilling.

Based on information shown on the site plan, we understand the general substation yard finish grade will slope downward from southeast to northwest from about elevation 332 to 318 feet. Considering the existing grades at the site, we anticipate cuts approaching 60 feet will be needed to achieve finish grade on the easterly side of the site and fills approaching 20 feet will be needed on the westerly side of the site.

Based on limited information available at this time, we anticipate the converter substation may include new equipment structures (transformers, dead-end, switchgear and steel pole structures) on the westerly side and a one story heated building on the easterly side. We understand the one-story, steel-framed building may be about 200 by 400 feet in plan dimensions with spread footing foundations and a slab-on-grade. We understand spread footings, surficial concrete pads, foundations with rock anchors and drilled shafts are being considered for equipment foundation support.

Since the substation is still in concept design, proposed equipment locations and structural loads and the actual size, location and structural loads for the proposed building are not known. Existing grades and possible proposed grading are shown on the “Exploration Location Plan” attached in Appendix B.

2.0 EXPLORATION AND TESTING

2.1 Explorations

Twelve test borings (B-1 through B-12) and three auger probes (P-1 through P-3) were made at the site during the period of March 15 through 20, 2018 by S. W. Cole Explorations, LLC. The exploration locations were selected by Power Engineers and established in the field by S. W. Cole Engineering, Inc. (S.W.COLE) using mapping grade GPS equipment. The approximate exploration locations are shown on the

"Exploration Location Plan" attached in Appendix B. Logs of the explorations and a key to the notes and symbols used on the logs are attached in Appendix C. The elevations shown on the logs were estimated based on topographic information shown on the "Exploration Location Plan".

Open standpipe piezometers were installed in borings B-3, B-7, B-9 and B-12. Piezometer installation details are noted on the logs.

2.2 Field Testing

The test borings were drilled using a combination of hollow-stem auger, solid-stem auger, cased wash-boring and NQ rock coring techniques. The soils were sampled at 2 to 5 foot intervals using a split-spoon sampler and Standard Penetration Testing (SPT) methods. SPT blow count results are shown on the logs.

Rock coring was performed at borings B-4, B-5, B-7, B-9, B-10 and B-12 using a NQ2 (2 in) core bit. At several borings, a roller bit was used to penetrate the surface of the bedrock prior to coring. At B-3, the borehole was advanced into the bedrock using solid stem auger and a roller cone in order to install a groundwater piezometer (no rock core).

2.3 Laboratory Testing

2.3.1 Geotechnical Laboratory Testing

Soil samples obtained from the explorations were returned to our laboratory for further classification and testing. Moisture content test results as well as Laboratory rock core compression and unit weight test results and RQD (Rock Quality Designation) are noted on the logs.

2.3.2 Laboratory Soil Chemistry Testing

Three soil samples were submitted to Alpha Analytical Services for determination of pH (EPA 9045), water soluble chloride content (EPA 9251) and water soluble sulfate content (EPA 9038) testing. Results of the pH and water soluble chloride and sulfate testing as well as sulfate exposure classifications in accordance with ACI 318 Table 4.3.1 are included in Appendix D and summarized in the following table:

Exploration/ sample interval	pH Testing	Chloride Testing (ppm)	Sulfate Testing (ppm)	Sulfate Exposure Classification (ACI 318 Table 4.3.1)
B-1 /0'-2'	5.4	< PQL	< PQL	Negligible
B-9/0'-2'	5.6	< PQL	< PQL	Negligible
B-11/5'-7'	6.8	< PQL	< PQL	Negligible

Notes
ppm = parts per million
PQL – Procedure Quantification Limit
PQL for chloride testing is 20 ppm
PQL for sulfate testing is 10 ppm

3.0 SUBSURFACE CONDITIONS

3.1 Soil and Bedrock

In general, the explorations encountered a soils profile consisting of forest duff and topsoil overlying medium dense silty sand overlying dense brown gravelly silty sand (glacial till) overlying bedrock. The topsoil and forest duff varies from about 6 inches to 1.5 feet in thickness at the explorations. Where encountered, the silty sand varies in thickness from about 1 to 5.5 feet and the glacial till varies in thickness from about 1 to 17 feet. Approximate depths to and elevations of apparent bedrock are shown below.

APPARENT DEPTH/ELEVATION TO BEDROCK			
Exploration/Approx. Surface Elevation (ft)	**Approximate Depth/Elevation (ft)**	**Exploration/Approx. Surface Elevation (ft)**	**Approximate Depth/Elevation (ft)**
B-1/308	1.0/307	B-9/339	4.0/335
B-2/304	11.2/293	B-10/333	6.2/327
B-3/309	2.5/306.5	B-11/304	5.0/299
B-4/314	4.8/309	B-12/378	3.5/374.5
B-5/311	7.2/304	P-1/330	4.5/325.5
B-6/318	4.0/314	P-2/345	7.5/337.5
B-7/311	4.9/306	P-3/334	5.0/329
B-8/310	18.0/292		

Photos of the recovered bedrock core are attached in Appendix C.

Not all the strata were encountered at each exploration; refer to the attached logs in Appendix C for more detailed subsurface information.

3.2 Groundwater

The soils encountered at the test borings were moist to wet from the ground surface. Saturated soils were encountered at depths varying from about 3 to 10 feet. Groundwater likely becomes perched on the relatively impervious silty clay and glacial till encountered at the test borings. Long term groundwater information is not available. It should be anticipated that groundwater levels will fluctuate, particularly in response to periods of snowmelt and precipitation, as well as changes in site use.

Open standpipe piezometers were installed in borings B-3, B-7, B-9 and B-12. Depths to groundwater were measured in the piezometers approximately 24 hours after installing the piezometers. Depths were measured to be about 4.5, 7.4, 9.8 and 23.6 (shallow)/29.6 (deep) feet below the existing ground surface at these borings, respectively, on March 21, 2018.

3.3 General Geological Conditions

The Maine Geological Survey (MGS) *Surficial Geologic Map of Maine* (Thompson and Borns, 1985) and the *Surficial Geologic Map of The Lake Auburn East Quadrangle, Maine*[1] (Hildreth, 2008) indicate the surficial geology of the project area consists of glacial till overlying bedrock with limited bedrock exposures possible in the general area. Field observations and boring overburden observations are generally consistent with the mapped surficial geology.

The MGS *Bedrock Geologic Map of Maine*[2] (Osberg et al., 1985) and detailed mapping of the *Bedrock Geology of the Lewiston 15-minute Quadrangle* (Hussey, 1983) interpret the bedrock in the project area to be Sangerville Formation. The Sangerville Formation in the area is described as impure marble, coarsely crystalized calc-silicate rocks, and feldspathic biotite- and hornblende biotite granofels, with garnet rich laminations.

The observed bedrock core, is generally consistent with the published geologic mapping with some variations. A calcareous feldspar pegmatite was observed in the upper 3 feet of the core recovered from boring B-5 (see boring logs and core photographs). This bedrock is generally described as a feldspar mica schist (equivalent to the feldspathic biotite granofels) with calc-silicates and variable amounts of garnet. Limited weathering and alternation associated with foliation plane fractures was observed, which may be related to seasonal variations in the water table.

[1] Thompson, W. B. and Borns, H. B., eds., 1985, Surficial Geologic Map of Maine, Maine Geological Survey.
[2] Osberg, P. H., Hussey, A. M. , and Boone, G. M., eds., 1985, Bedrock Geologic Map of Maine, Maine Geological Survey.

3.4 Seismic – Faulting Data

Seismic activity can impact a site from two sources: ground rupture directly beneath a site or shaking produced at the site from nearby seismic activity. There are no documented cases of ground rupture that can be definitely attributed to seismic activity in New England since the departure of glaciers more than 10,000 years ago. Bedrock deformation has occurred over geologic time; however, evidence of faulting in the project area is limited to inferred faults associated with bedrock contacts and observed healed angular bedrock conglomerate and wacke observed in the core.

3.5 Seismic and Frost Conditions

According to IBC 2015/ASCE 7, we interpret the following Seismic Site Classes using the N-Value method for soil:

- Seismic Site Class B (for foundations on sound bedrock)
- Seismic Site Class D (for foundations on compacted fill or native soil)

We recommend the following seismic design parameters for the 2,500-year design earthquake:

RECOMMENDED SEISMIC DESIGN PARAMETERS (2,500-year Design Earthquake)		
Peak Ground Acceleration (PGA)	0.2-second Spectral Acceleration (S_s)	1-second Spectral Acceleration (S_1)
0.186	0.249g	0.081g

NOTE: Seismic design parameters from USGS accessed April 12, 2018. (https://earthquake.usgs.gov/designmaps/us/application.php)

Liquefiable soils typically consist of loose, fine sands and non-plastic silts below the groundwater table. Based on the subsurface findings, it is our opinion the soils at the site are not susceptible to liquefaction during a seismic event and therefore the risk of lateral spread and seismic induced settlement are negligible.

The 100-year Air Freezing Index for the Lewiston area is about 1,500 Fahrenheit degree days, which corresponds to a frost penetration depth on the order of 5.0 feet. We recommend foundations exposed to freezing be covered with at least 5.0 feet of soil for frost protection.

4.0 EVALUATION AND RECOMMENDATIONS

4.1 General Findings

Based on the subsurface findings and limited project information at this time, the proposed construction appears feasible from a geotechnical standpoint. The principle geotechnical considerations include:

- Bedrock Excavations: Based on the subsurface conditions encountered, bedrock excavation and removal will require blasting to achieve the necessary grades.

- Converter Station Pad: All topsoil and organics, soils with roots and disturbed or soft yielding soil must be completely removed from beneath the proposed converter station pad and embankment areas. We recommend bedrock removal extend to at least 6 feet below finish substation pad grade to allow for a 6 foot thick zone of material including the pad surface (designed by others) overlying compacted Gravel Borrow to allow for excavations for shallow foundations and subgrade utilities.

- Building Structure: Spread footing foundations and a slab-on-grade floors bearing on properly prepared subgrades appear suitable for the proposed building. Building footings should bear on at least 12-inches of compacted Structural Fill overlying properly prepared subgrades. On-grade floor slabs for heated structures should bear on at least 12-inches of compacted Structural Fill overlying properly prepared subgrades.

- Equipment Foundations: We recommend substation equipment foundations bear on at least 12-inches of compacted Structural Fill overlying properly prepared subgrades. Foundations for heavier, moment carrying structures such as A-frames are anticipated to bear directly on sound, intact bedrock with rock anchors, or on caissons drilled into the bedrock to resist overturning.

- Groundwater: The depth to groundwater upon completion of the test borings ranged from within a few feet of the ground surface to depths of about 24 and 30 feet below ground surface at boring B-12. Excavations will require dewatering techniques to help control below excavation grades.

- Reuse of Native Soils: In our opinion, the native, non-organic granular soils can likely be reused as mass embankment fill provided they are at a moisture content that is workable for achieving the required compaction. The silty sand and glacial till soils are moisture sensitive and may be difficult to compact when above the optimum moisture content. Therefore, we do not recommend reuse of the native soils during wet and freezing conditions.

- Reuse of Blasted Bedrock: The bedrock is a resource for production of embankment fills. The blasted bedrock can be used as Rock Borrow for embankment fill provided the rock is crushed to be well graded and the maximum particle size is less than 24 inches and used in appropriate size lifts. The Rock Borrow should be mixed with sands and gravel and finer rock particles to reduce the percentage of voids in the fill. However, where there is a lack of overburden soil available or the blasting and/or crushing operations create a poorly graded borrow; the use of a choke stone material will be required to fill voids in each lift of Rock Borrow.

4.2 Site and Subgrade Preparation

We recommend that site preparation begin with the construction of an erosion control system to protect adjacent drainage ways and areas outside the construction limits. Surficial organics, roots and topsoil should be completely removed from areas of proposed fill and construction. As much vegetation as possible should remain outside the construction areas to lessen the potential for erosion and site disturbance.

Based on the subsurface findings, the thickness of forest duff and/or topsoil varies across the site. The contractor should anticipate areas where roots and soils containing organics will extend several feet into the underlying soil. The methods used by the contractor for removal and the moisture condition of the site will affect the volume of material removal required. Topsoil and organics may be stockpiled and screened for reuse as a new topsoil layer in landscape areas. Suitability of the topsoil re-use from a nutrient and fertility standpoint should be evaluated by soil testing prior to its use.

4.3 Excavation and Dewatering

4.3.1 Excavations

Excavations will generally encounter forest duff and topsoil, silty sand and glacial till with varying amounts of gravel and cobbles and boulders, and shallow bedrock. Care must be exercised during construction to reduce potential for disturbance of subgrades. We recommend a smooth-edged bucket be utilized to excavate to final subgrade in soils. Construction traffic on wet soil subgrades should be avoided when practical. Should subgrades become disturbed, the subgrade should be over-excavated to expose suitable soil and replaced with compacted Structural Fill or Crushed Stone or moisture conditioned glacial till and be compacted.

Based on the proposed grading and subsurface conditions, mass bedrock removal will be needed to achieve the required subgrade elevations. Bedrock removal will require drilling and blasting techniques. We recommend a licensed blasting contractor be engaged for bedrock removal. Pre-blast surveys should be completed on surrounding structures (including interior walls), water supply wells and infrastructure prior to commencing blasting activities. Vibrations due to blasting should be monitored during construction. In addition, we recommend the subcontractor submit a detailed drilling and blasting plan with qualifications and references prior to blasting.

Temporary, unsupported soil excavations should be sloped back to 1½(H):1(V) or flatter. In all cases, excavations must be properly shored and/or sloped according to OSHA regulations to prevent sloughing and caving of the sidewalls during construction.

4.3.2 Dewatering

Sumping and pumping and the use of temporary diversion ditching dewatering techniques should be adequate to control water inflow into excavations above the groundwater table. When working at the bottom of slopes, temporary dewatering may require construction of uphill cut-off swales and/or diversion berms to direct up gradient runoff water away from the work areas.

4.4 Embankment Construction

The proposed topographic information shown on the plan indicates fill soil slopes for the substation pad will generally be constructed with slopes of 2(H):1(V) or flatter and cut slopes will generally be constructed with slopes of 3(H):1(V) or flatter.

4.4.1 General

Fill slopes should be constructed as level benches, which are overbuilt to facilitate compaction. The final slope face should be constructed by cutting back into the compacted core prior to placing slope surface materials. Fill slopes constructed on existing terrain steeper than 3(H):1(V) should be keyed into the existing ground surface with continuous level benches. Fill slopes constructed on existing slopes flatter than 3(H):1(V) do not need continuous benching. We recommend a 10 foot wide bench be cut into the native soil beneath the toe of fill slopes for installation of a 1-foot thick drainage blanket consisting of Gravel Borrow or Rock Borrow mixed with Gravel Borrow prior to placing fill soils. The drainage blanket should be day-lighted for gravity drainage.

4.4.2 Fill Slopes 2(H):1(V) or Flatter

Fill materials needed to construct fill slopes at inclinations of 2(H):1(V) or flatter should consist of compacted Common Borrow, Gravel Borrow, Rock Borrow, Structural Fill or Crushed Stone. Exposed soil slopes will be susceptible to surface erosion, slumping and sloughing, particularly during heavy rain and freeze/thaw events. Exposed slopes should be surfaced with an erosion control blanket and loam and seed, as soon as practicable, to create a vegetated mat. In areas of concentrated surface water, we recommend 8-inch minus rip-rap overlying a geotextile fabric be used in lieu of the erosion blanket and loam and seed. We recommend cross-slope stone lined drainage channels underlain with geotextile fabric be construct into the slope face when the height of the embankment exceeds 25 feet.

4.4.3 Fill Slopes Steeper than 2(H):1(V)

Although not anticipated, if proposed fill slopes are to be constructed steeper than 2(H):1(V), we recommend these slopes be constructed with compacted Rock Borrow and the slopes be covered with at least 2 feet of compacted rip-rap. Further, lateral edges where the riprap terminates along the face of the embankment should be similarly keyed into the ground surface. We recommend slopes be constructed no steeper than 1.5(H):1(V). Rock Borrow should be controlled to maximum particle size of 24 inches and be placed in horizontal lifts not exceeding 36 inches. The Rock Borrow should be placed in a manner to reduce the potential for voids by infilling with sand and smaller stone particles to create a well graded matrix. If overburden soil is not available for infilling or the blasting operations create a course poorly graded rock borrow lacking fines, a choke stone layer will be required for between each lift and at the top of subgrade prior to placing aggregate road base products.

4.4.4 Cut Slopes

We recommend proposed soil cut slopes less than 15 feet in height consider slope inclinations of 2H: 1V or flatter since the depth to bedrock is unknown between exploration locations and areas of outcropping bedrock. The final slope inclination will be dependent on the subsurface conditions (soil or bedrock) encountered during construction. Cut slopes in bedrock should be sloped back to a stable condition, which will depend on rock fracturing, as well as bedrock formation strike and dip in relation to slope orientation. We recommend a representative from S.W.COLE observe the bedrock slopes during construction.

We recommend a rock fall catchment zone be provided at the toe of rock cut slopes following FHWA Publication No. HI-99-007 *Rock Slopes Reference Manual.*

In addition, we recommend a minimum 5-foot wide bench be constructed at the interface of the overburden soil and bedrock to reduce potential erosion that could cause soils, cobbles and boulders to wash down the rock slopes potentially clogging drainage swales and causing blocking hazards.

In areas of concentrated surface water or locations of groundwater seeps, rip-rap should be used in lieu of the erosion blanket and loam/seed. We recommend cross-slope stone lined drainage channels underlain with geotextile fabric be constructed into the slope when the height of the slope exceeds 25 feet.

4.4.5 Slope Surface Erosion Control

Unprotected and un-established slopes, regardless of inclination, will be susceptible to surface erosion, slumping, and sloughing especially during precipitations and freeze/thaw events. Topsoil and seed should be installed, as soon as practicable, to create a vegetated mat over the entire surface of the slope. We recommend the use of UV resistant synthetic erosion control mesh to reinforce the surface soils until the vegetated mat is established, particularly if constructed during the winter or spring seasons.

Groundwater seepage and up gradient runoff water can make establishment of soil slopes difficult. In areas where surface water may be concentrated and discharged over the slope or where groundwater seepage is encountered, we recommend locally covering the slope with a small diameter rip-rap placed over a layer of crushed gravel and a woven filter fabric.

4.5 Foundations

4.5.1 Building and Equipment Foundations:

We recommend the proposed building foundation be supported on spread footings founded on at least 12-inches of compacted Structural Fill overlying compacted Gravel Borrow. Non-moment-carrying equipment foundations and lightweight equipment pads should also be founded on at least 12-inches of compacted Structural Fill overlying compacted Gravel Borrow. For foundations bearing on properly prepared subgrades, we recommend the following geotechnical parameters for design consideration:

GEOTECHNICAL PARAMETERS	
Net Allowable Soil Bearing Pressure	4.0 ksf or less (Spread Footings on compacted structural fill or crushed stone)
Net Allowable Bedrock Bearing Pressure	15.0 ksf (Clean, sound, intact bedrock)
Design Frost Depth of Footings on Soil	5.0 ft
Design Frost Depth for Footings Pinned to Sound Bedrock Depth	2.5 ft
Base Friction Factor	0.35 (Mass concrete to structural fill)
Base Friction Factor	0.45 (Mass concrete to bedrock)
Passive Lateral Earth Pressure Coeff. (K_p)	3.0 (compacted Structural Fill)
Equivalent Fluid Pressure (Passive)	390 psf/ft (compacted Structural Fill)
Active Lateral Earth Pressure Coeff. (K_a)	0.3 (compacted Structural Fill)
Equivalent Fluid Pressure (Active)	40 psf/ft (compacted Structural Fill)
At-Rest Lateral Earth Pressure Coeff. (K_o)	0.5 (compacted Structural Fill)
Equivalent Fluid Pressure (At-Rest)	60 psf/ft (compacted Structural Fill)
Total Unit Weight of Backfill (γ_t)	125 pcf (compacted Structural Fill)
Internal Friction Angle (Φ)	32 degrees (compacted Structural Fill)

Spread footings should be at least 24 inches in width regardless of the bearing pressure. We recommend spread footings be placed on at least 12 inches of compacted Structural Fill (if overlying soil or soil fills) or at least 12 inches of Crushed Stone (if overlying fractured bedrock or blasted bedrock fills). We understand all foundations and concrete structures and slabs will be designed by others.

4.5.2 Rock Anchorage:

Based on the subsurface conditions and guidance from the Post-Tensioning Institute's manual entitled *Recommendations for Prestressed Rock and Soil Anchors* (PTI, 2004), we recommend the use of prestressed, Class I corrosion protection, grouted rock anchors be considered by the foundation designer where rock anchors are being considered. We recommend the following geotechnical parameters for preliminary rock anchor design consideration:

GEOTECHNICAL PARAMETERS FOR ROCK ANCHORS	
RQD of Rock Core (see boring logs)	55 to 100%
Average Dry Unit Weight of Bedrock Samples	174 pcf
Rock Cone Pull-Out Angle (from vertical)	45 degrees (from vertical)
Average Ultimate Grout to Bedrock Bond Strength	120 psi

Based on guidance from the *Recommendations for Prestressed Rock and Soil Anchors* (PTI, 2004) we recommend a minimum unbonded length (free-stressing length) of 15 feet for strand tendons and 10 feet for bar tendons be considered for preliminary rock anchor design. The bonded length will depend upon the uplift load and the diameter of the drill hole. Rock anchor spacing should be at least 1.2 times the free-stressing length; closer spacing will reduce allowable anchor loads. Rock anchors installed in groups should be designed with consideration of pullout resistance from overlapping failure surfaces extending from the midpoint of the anchor bond zone to the bedrock surface.

The drill-hole for each rock anchor should be cleaned of any drilling fines and tightness tested to determine the need for pre-grouting. Rock anchors should be installed, tested and locked-off according to the design engineer's recommendations.

4.5.3 A-Frame Foundations

We anticipate A-Frames structures will be constructed within the westerly portion of the proposed substation. Structural loads and locations are not known at this time. Based on the findings at the explorations, depths to bedrock may vary from about 6 feet (below Gravel Borrow zone) to nearly 20 feet in the low area in the northwesterly corner.

Depending upon anticipated structural loads, we anticipate A-Frame foundations will need to derive support from the underlying bedrock. Depending upon the location, the foundation could consist of a large mat foundation bearing on and pinned to bedrock, or if rock is deep, drilled shafts socketed into bedrock. If glacial till is encountered we recommend excavation continue to bedrock, creating a level bearing area. Soft, weathered bedrock, if encountered, should be removed. An allowable bearing contact pressure of 15.0 ksf or less should be considered for sound, intact bedrock. A concrete leveling mat may be placed on the prepared bedrock surface prior to placing reinforced concrete foundations. The foundation should be anchored to the bedrock if the rock is sloping steeper than 3(H):1(V) and/or if structural loads dictate. The leveling mat should extend beyond the footing edges or piers by at least 24 inches. Rock anchors extending into bedrock will likely be needed to provide uplift capacity for the A-Frame pier foundations. We understand the A-frame foundation type and design will be by the project structural engineer.

4.6 Foundation Drainage

We recommend an underdrain system be installed on the outside edge of the perimeter building footings. The underdrain pipe should consist of 4-inch diameter, perforated SDR-35 foundation drain pipe bedded in Crushed Stone and covered with non-woven geotextile fabric. The underdrain pipe must have a positive gravity outlet protected from freezing, clogging and backflow. Surface grades should be sloped away from the building and other structures for positive surface water drainage. General underdrain details are illustrated on the "Foundation Detail Sketch" attached in Appendix B.

4.7 Slab-On-Grade

On-grade floor slabs in heated areas may be designed using a subgrade reaction modulus of 120 pci (pounds per cubic inch) provided the slab is underlain by at least 12-inches of compacted Structural Fill placed over properly prepared subgrades. The structural engineer or concrete consultant must design steel reinforcing and joint spacing appropriate to slab thickness and function.

We recommend a sub-slab vapor retarder particularly in areas of the building where the concrete slab will be covered with an impermeable surface treatment or floor covering that may be sensitive to moisture vapors. The vapor retarder must have a permeance that is less than the floor cover or surface treatment that is applied to the slab. The vapor retarder must have sufficient durability to withstand direct contact with the sub-slab base material and construction activity. The vapor retarder material should be placed according to the manufacturer's recommended method, including the taping and lapping of all joints and wall connections. The architect and/or flooring consultant should select the vapor retarder products compatible with flooring and adhesive materials.

The floor slab should be appropriately cured using moisture retention methods after casting. Typical floor slab curing methods should be used for at least 7 days. The architect or flooring consultant should assign curing methods consistent with current applicable American Concrete Institute (ACI) procedures with consideration of curing method compatibility to proposed surface treatments, flooring and adhesive materials.

4.8 Backfill and Compaction

Although a wide range of soil materials can be used successfully, it has been our experience granular soils with good drainage characteristics provide significant advantages particularly in wet conditions and during cold weather construction. We have made recommendation for materials that are suitable for support of the proposed construction from a geotechnical standpoint. However, the electrical designer must develop parameters for fill to achieve proper compatibility between the fill soils and the electrical grounding system. In general, we recommend the following materials for consideration:

Common Borrow: Fill to raise grades in landscape areas.

Gravel Borrow: Fill to raise grades in the converter station pad area above bedrock and/or rock borrow should be sand or silty sand meeting the requirements of 2014 MaineDOT Standard Specification 703.20 Gravel Borrow. We anticipate Gravel Borrow will be made from on-site crushing of blasted bedrock and blending with existing granular fills or imported sand.

Rock Borrow: Blasted bedrock used for embankment fill should be hard durable blasted bedrock broken to various sizes of 2 feet minus to form a compact embankment with minimum of voids and meeting the requirements of 2014 MaineDOT Standard Specification 703.21. Finer crushed bedrock and granular soil shall be worked into the surface of each lift as necessary to fill voids.

Structural Fill: Backfill below footings, equipment pads, adjacent to foundations and material below floor slabs should be clean, non-frost susceptible sand and gravel meeting the gradation requirements for Structural Fill as given below:

Structural Fill	
Sieve Size	**Percent Finer by Weight**
4 inch	100
3 inch	90 to 100
¼ inch	25 to 90
#40	0 to 30
#200	0 to 6

Crushed Stone: Crushed Stone, used for underdrain aggregate should be washed ¾-inch crushed stone meeting the requirements of 2014 MaineDOT Standard Specification 703.22 Underdrain Backfill Material Type C.

Reuse of Site Soils: The non-organic on-site granular soils are likely suitable to blend and process with crushed blasted bedrock to create Gravel Borrow provided they are at a compactable moisture content at the time of blending and reuse. The native till may be suitable for reuse as Common Borrow, such as pond berms, provided it is at a compactable moisture content at the time of reuse.

Placement and Compaction: Fill should be placed in horizontal lifts and compacted such that the desired density is achieved throughout the lift thickness with 3 to 5 passes of the compaction equipment. Loose lift thicknesses for grading, fill and backfill activities should not exceed 12 inches. We recommend that fill and backfill in building and paved areas be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557. Crushed Stone should be compacted with 3 to 5 passes of a vibratory plate compactor having a static weight of at least 500 pounds. Rock Borrow should be placed in lifts approximating the largest material diameter size and be thoroughly tracked in with heavy tracked equipment with several passes in several directions.

4.9 Weather Considerations

Construction activity should be limited during wet and freezing weather and the site soils may require drying or thawing before construction activities may continue. The contractor should anticipate the need for water to temper fills in order to facilitate compaction during dry weather. If construction takes place during cold weather, subgrades, foundations and floor slabs must be protected during freezing conditions. Concrete and fill must not be placed on frozen soil; and once placed, the concrete and soil beneath the structure must be protected from freezing.

4.10 Design Review and Construction Testing

S.W.COLE should be retained to review the construction documents prior to bidding to determine that our earthwork and foundation recommendations have been properly interpreted and implemented.

A soils and concrete testing program should be implemented during construction to observe compliance with the design concepts, plans, and specifications. S.W.COLE is available to observe earthwork activities, the preparation of foundation bearing surfaces and installation of rock anchors, as well as to provide testing and IBC Special Inspection services for soils, concrete, steel, spray-applied fireproofing, structural masonry and asphalt construction materials.

4.11 Recommendations for Additional Study

We understand design of the converter station pad, building and equipment is still in development. Additional explorations, laboratory soils and rock testing and evaluation is likely needed as design of the converter station progresses. Field soil resistivity and an acidic rock evaluation should also be made.

5.0 CLOSURE

It has been a pleasure to be of assistance to you with this phase of your project. We look forward to working with you during the design and construction phase of the project.

Sincerely,

S. W. Cole Engineering, Inc.

STATE OF MAINE
PAUL F.
KOHLER
No. 7145
LICENSED
PROFESSIONAL ENGINEER

Paul F. Kohler, P.E.
Senior Geotechnical Engineer

PFK:mas/tjb

APPENDIX A

Limitations

This report has been prepared for the exclusive use of Central Maine Power Company for specific application to the proposed Converter Station on Merrill Road in Lewiston, Maine. S. W. Cole Engineering, Inc. (S.W.COLE) has endeavored to conduct our services in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

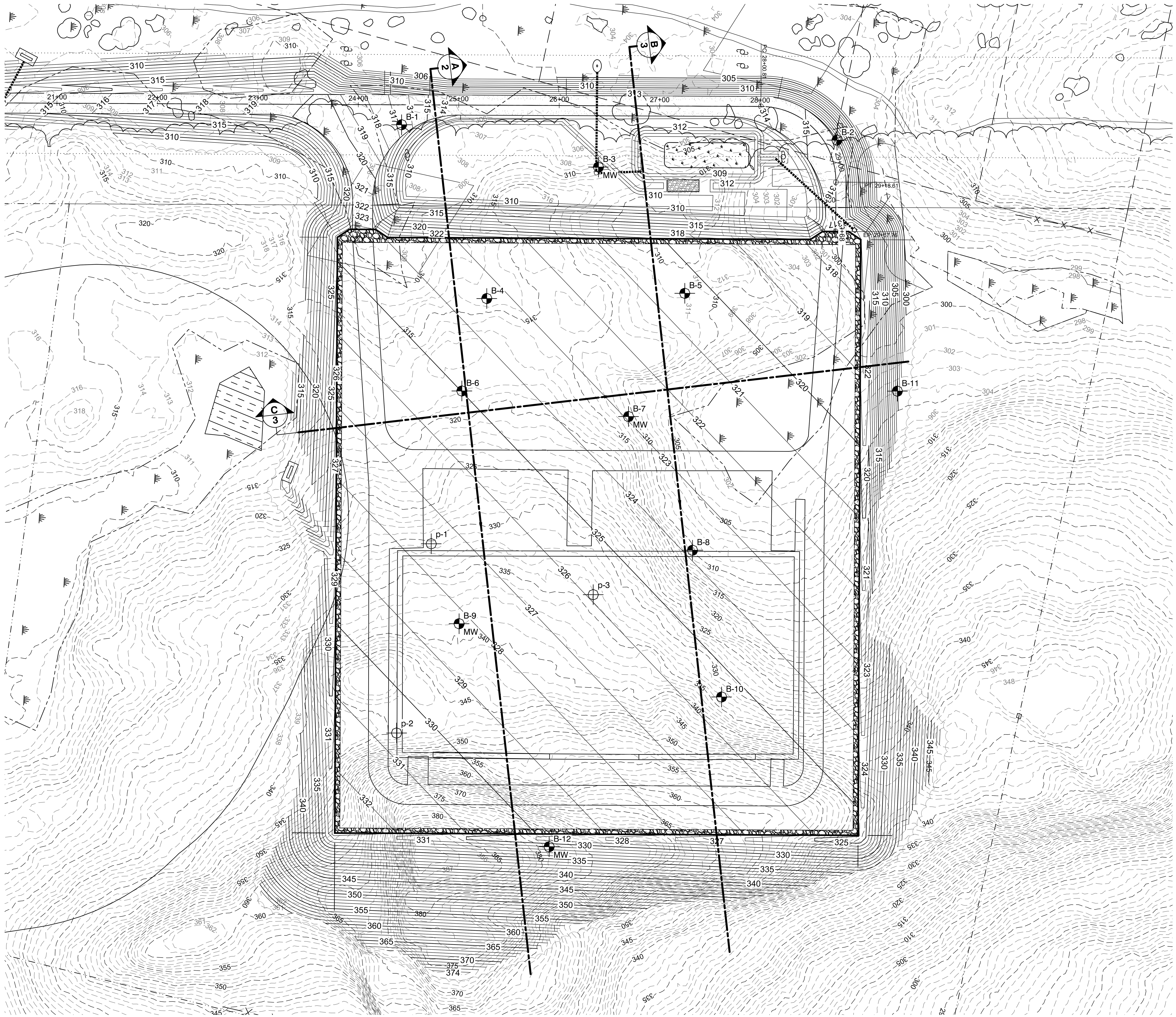
Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

S.W.COLE's scope of services has not included the investigation, detection, or prevention of any Biological Pollutants at the project site or in any existing or proposed structure at the site. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and the byproducts of any such biological organisms.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S.W.COLE should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S.W.COLE.

APPENDIX B

Figures



LEGEND:

- APPROXIMATE BORING LOCATION
- MW APPROXIMATE BORING LOCATION WITH MONITORING WELL
- APPROXIMATE PROBE LOCATION

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A 1"=100' SCALE PLAN OF THE SITE ENTITLED "BORING LOCATION PLAN, PROPOSED CONDITIONS," PREPARED BY POWER ENGINEERS, INC., DATED 4/10/2018.
2. THE BORINGS WERE LOCATED IN THE FIELD BY GPS SURVEY BY S. W. COLE ENGINEERING, INC. USING A MAPPING GRADE TRIMBLE GPS RECEIVER.
3. THIS PLAN SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S. W. COLE ENGINEERING, INC. GEOTECHNICAL REPORT.
4. THE PURPOSE OF THIS PLAN IS ONLY TO DEPICT THE LOCATION OF THE EXPLORATIONS IN RELATION TO THE EXISTING CONDITIONS AND PROPOSED CONSTRUCTION AND IS NOT TO BE USED FOR CONSTRUCTION.

0 50 100 Feet

NO.	DATE	DESCRIPTION	BY
1	05/11/2018	FINAL REPORT SUBMISSION	CEM
0	05/02/2018	PRELIMINARY FINDINGS SUBMISSION	CEM

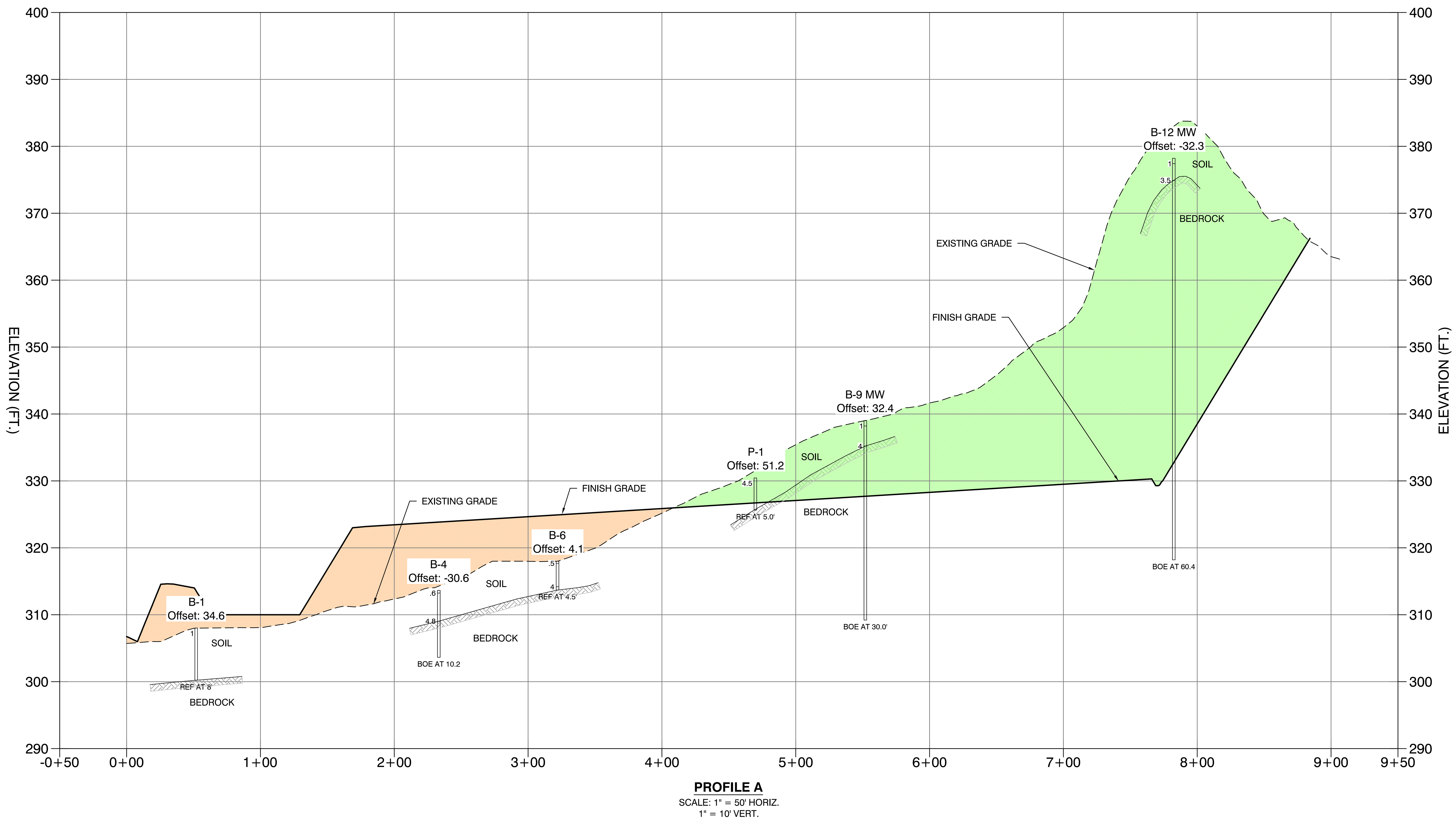
S.W.COLE ENGINEERING, INC.

CENTRAL MAINE POWER

EXPLORATION LOCATION PLAN

PROPOSED AC/DC CONVERTER STATION
MERRILL ROAD
LEWISTON, MAINE

Job No.:	17-1017	Scale:	As Noted
Date :	05/02/2018	Sheet:	1



PROFILE A

SCALE: 1" = 50' HORIZ.
1" = 10' VERT.

LEGEND

B-9 (MW) BORING NUMBER PIEZOMETER INSTALLED

APPROXIMATE EXISTING GROUND SURFACE

7' STRATA CHANGE

SILT STRATA DEFINITION

BOE BOTTOM OF EXPLORATION

NOTES:

1. THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTION WERE GENERALIZED FROM AND INTERPOLATED BETWEEN EXPLORATION LOCATIONS. THE TRANSITION BETWEEN MATERIALS MAY BE MORE OR LESS GRADUAL THAN INDICATED. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE SPECIFIC LOCATIONS INDICATED AND AT THE TIME OF EXPLORATION. SEE BORING LOGS FOR MORE DETAILED INFORMATION.

2. THIS PROFILE SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S. W. COLE ENGINEERING, INC. GEOTECHINCAL REPORT AND IS NOT TO BE USED FOR CONSTRUCTION.

NO.	DATE	DESCRIPTION	BY
1	05/11/2018	FINAL REPORT SUBMISSION	CEM
0	05/02/2018	PRELIMINARY FINDINGS SUBMISSION	CEM

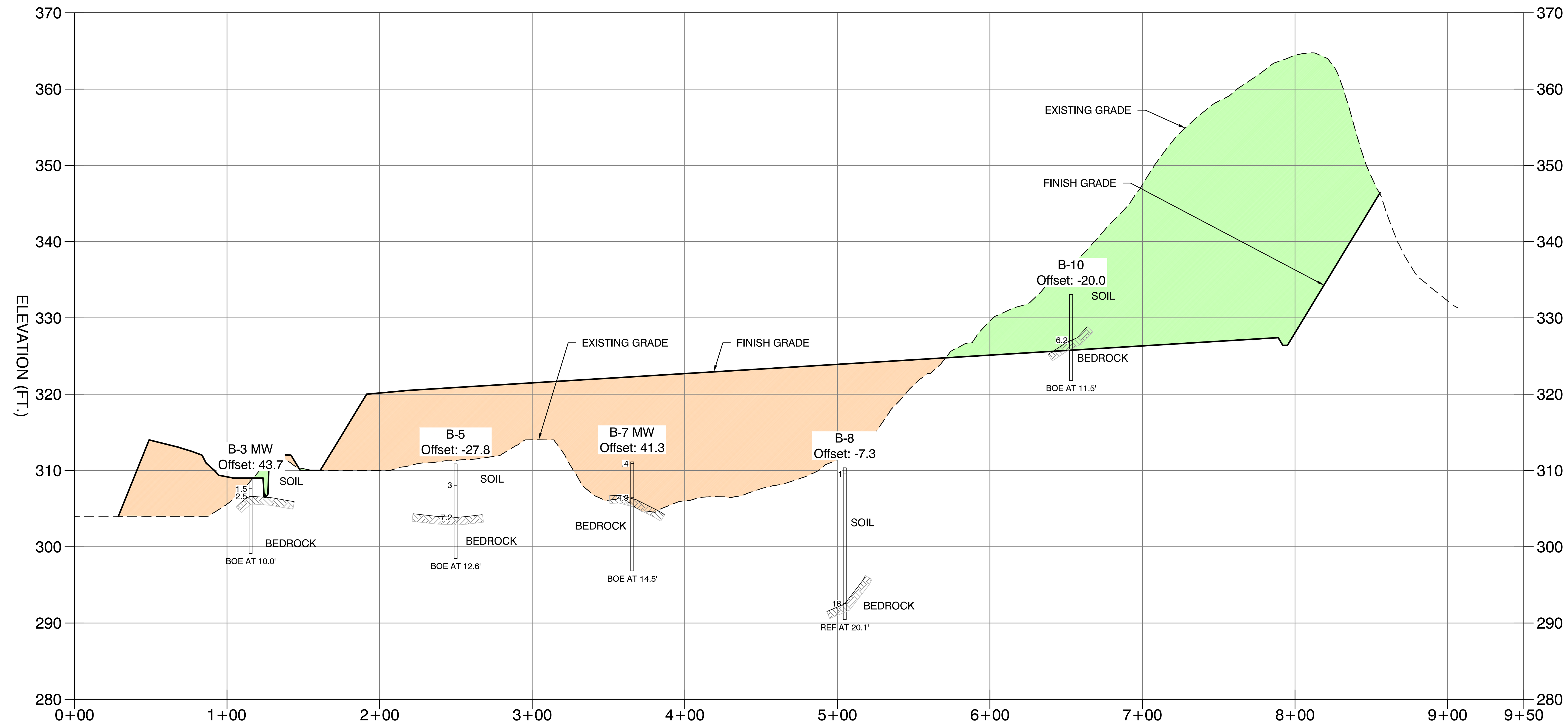
S.W.COLE ENGINEERING, INC.

CENTRAL MAINE POWER

INTERPRETIVE GEOLOGIC PROFILE A

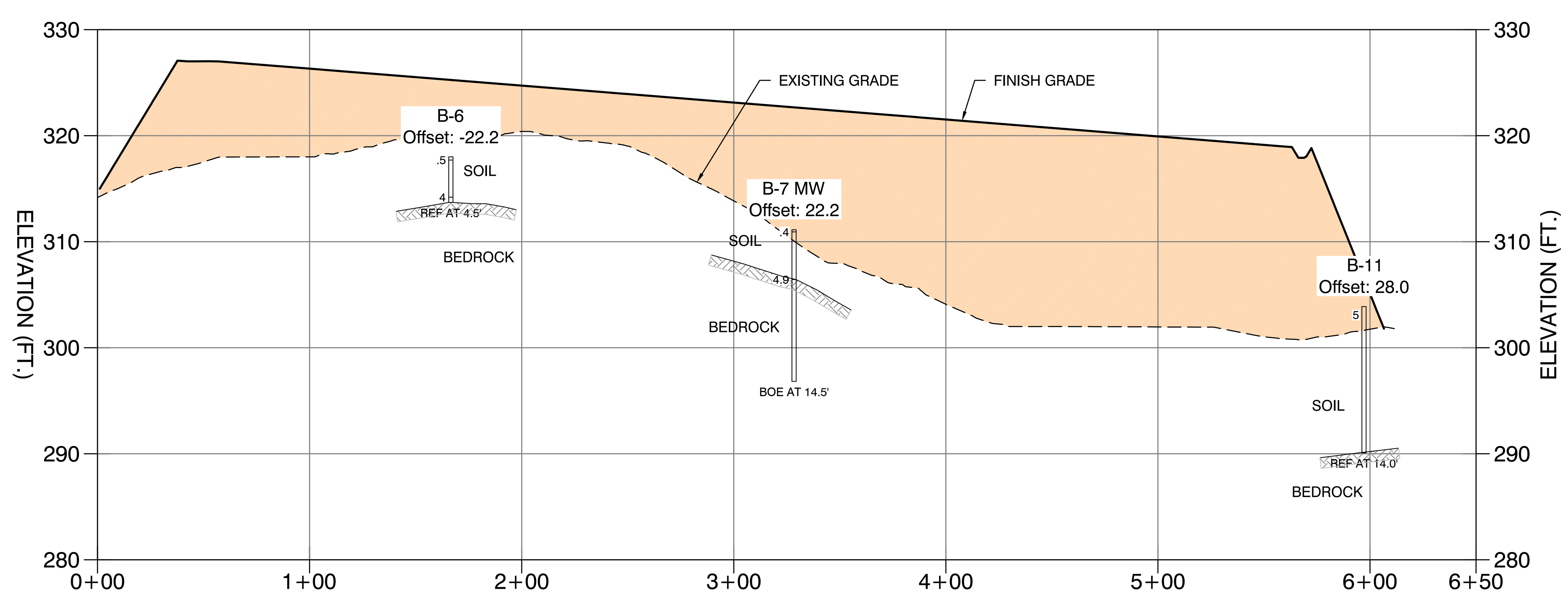
PROPOSED AC/DC CONVERTER STATION
MERRILL ROAD
LEWISTON, MAINE

Job No.:	17-1017	Scale:	As Noted
Date :	05/02/2018	Sheet:	2



PROFILE B

SCALE: 1" = 50' HORIZ.
1" = 10' VERT.



PROFILE C

SCALE: 1" = 50' HORIZ.
1" = 10' VERT.

LEGEND

B-9 (MW)	BORING NUMBER PIEZOMETER INSTALLED
	APPROXIMATE EXISTING GROUND SURFACE
7'	STRATA CHANGE
SILT	STRATA DEFINITION
BOE	BOTTOM OF EXPLORATION

NOTES:

1. THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTION WERE GENERALIZED FROM AND INTERPOLATED BETWEEN EXPLORATION LOCATIONS. THE TRANSITION BETWEEN MATERIALS MAY BE MORE OR LESS GRADUAL THAN INDICATED. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE SPECIFIC LOCATIONS INDICATED AND AT THE TIME OF EXPLORATION. SEE BORING LOGS FOR MORE DETAILED INFORMATION.
2. THIS PROFILE SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S. W. COLE ENGINEERING, INC. GEOTECHINCAL REPORT AND IS NOT TO BE USED FOR CONSTRUCTION.

NO.	DATE	DESCRIPTION	BY
1	05/11/2018	FINAL REPORT SUBMISSION	CEM
0	05/02/2018	PRELIMINARY FINDINGS SUBMISSION	CEM

S.W.COLE
ENGINEERING, INC.

CENTRAL MAINE POWER

INTERPRETIVE GEOLOGIC PROFILES B & C

PROPOSED AC/DC CONVERTER STATION
MERRILL ROAD
LEWISTON, MAINE

Job No.:	17-1017	Scale:	As Noted
Date :	05/02/2018	Sheet:	3

APPENDIX C

Exploration Logs and Key and Rock Core Photos

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

BORING NO.: B- 1
SHEET: 1 of 1
PROJECT NO. 17-1017
DATE START: 3/15/2018
DATE FINISH: 3/15/2018

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 308' +/- **TOTAL DEPTH (FT):** 8.0 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Scott Hollabaugh **DRILLING METHOD:** Hollow Stem Auger
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** 2 1/4 in / 5 5/8 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A /N/A **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.87 **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): ▼ 2.5 ft 3/20/2018 Borehole open to 5.5' +/-
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling

D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear

Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot

WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector

S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D		0-2	24/14	2-2-5-21			Forest Duff, topsoil and organics		
									1.0	Dense, brown Gravelly Silty SAND (Glacial Till)	▼	
305												
	5		2D		5-5.3	3/3	50/3"					
300									8.0	Refusal at 8.0 feet Probable Bedrock		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 1

BORING LOG

BORING NO.:	B- 2
SHEET:	1 of 1
PROJECT NO.	17-1017
DATE START:	3/15/2018
DATE FINISH:	3/15/2018

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 304' +/- **TOTAL DEPTH (FT):** 11.5 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Scott Hollabaugh **DRILLING METHOD:** Hollow Stem Auger
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** 2 1/4 in / 5 5/8 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A /N/A **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.87 **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): ⊻ 2.4 ft 3/20/2018 Borehole open to 3' +/-
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
⊽ At time of Drilling
⊻ At Completion of Drilling
⊻ After Drilling

D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear

Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot

WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector

S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D		0-2	24/16	2-1-8-11			Forest Duff, topsoil and organics		
									1.0	Medium dense, gray Silty fine SAND	⊻	
300	5		2D		4-6	24/10	19-21-18-16		3.0	Dense, brown Silty Gravelly SAND with cobbles (Glacial Till)		
295	10		3D		9-11	24/22	32-33-36-49		9.0	Very dense, gray Gravelly Silty SAND with cobbles (Glacial Till)		
									11.2 / 11.5	Probable Weathered Bedrock		

Refusal at 11.5 feet
Probable Bedrock

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 2

S.W.COLE ENGINEERING, INC.	# BORING LOG	**BORING NO.:**	**B- 3**
	CLIENT: Central Maine Power	**SHEET:**	1 of 1
	PROJECT: Proposed AC/DC Converter Substation	**PROJECT NO.**	17-1017
	LOCATION: Merrill Road, Lewiston, Maine	**DATE START:**	3/15/2018
		DATE FINISH:	3/15/2018

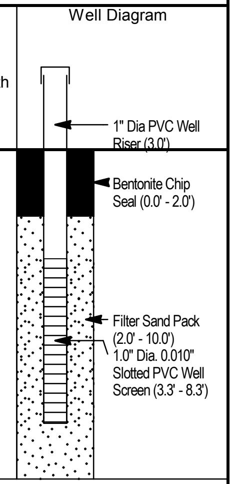
Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 309' +/- **TOTAL DEPTH (FT):** 10.0 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Scott Hollabaugh **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.87 **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): ∇ 4.5 ft 3/21/2018 Piezometer Installed
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level: ∇ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_U = Unconfined Compressive Strength, kips/sq.ft.; N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth
			1D		0-2	24/18	2-4-4-45		0.5	Forest Duff, topsoil and organics	
									1.5	Medium dense, reddish-brown Silty SAND, some gravel	
									2.5	Dense, brown Gravelly Silty SAND (Glacial Till)	
305										Bedrock	∇
	5									Advanced by SSA and rollercone to 10' (for well installation)	
300											
	10								10.0	Bottom of Exploration at 10.0 feet	

Well Diagram



Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

S.W.COLE ENGINEERING, INC.

BORING LOG

BORING NO.:	B- 4
SHEET:	1 of 1
PROJECT NO.	17-1017
DATE START:	3/20/2018
DATE FINISH:	3/20/2018

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 314' +/- **TOTAL DEPTH (FT):** 10.2 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Scott Hollabaugh **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2
HAMMER EFFICIENCY FACTOR: 0.87 **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): ▼ 2.3 ft 3/20/2018 Borehole open to 8.0' +/-
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
▽ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D		0-2	24/13	3-4-6-6			Forest Duff, topsoil and organics		
									0.6	Medium dense, brown Silty SAND, some gravel	▼	
310	5								4.8	Bedrock, Mica Schist / Calcsilicate and Hornblende with garnet, locally coarse		
			R1		5.2-10.2	60/50	55					
305	10								10.2	Bottom of Exploration at 10.2 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 4

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

BORING NO.: B- 5
SHEET: 1 of 1
PROJECT NO. 17-1017
DATE START: 3/20/2018
DATE FINISH: 3/20/2018

Drilling Information

LOCATION: See Exploration Location Plan
ELEVATION (FT): 311' +/-
TOTAL DEPTH (FT): 12.6
LOGGED BY: Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC
DRILLER: Scott Hollabaugh
DRILLING METHOD: Cased Boring
RIG TYPE: Track Mounted Diedrich D-50
AUGER ID/OD: N/A / N/A
SAMPLER: Standard Split-Spoon
HAMMER TYPE: Automatic
HAMMER WEIGHT (lbs): 140
CASING ID/OD: 4 in / 4 1/2 in
CORE BARREL: NQ2 / 2
HAMMER EFFICIENCY FACTOR: 0.87
HAMMER DROP (inch): 30
WATER LEVEL DEPTHS (ft): Borehole caved - no groundwater readings
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling

D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear

Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot

WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector

S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
			1D		0-2	24/6	2-2-3-3			Forest Duff, topsoil and organics		
310									0.5	Medium dense, reddish-brown Silty SAND		
									3.0	Dense, brown Silty Gravelly SAND (Glacial Till)		
	5											
305			2D		5-7	24/22	14-19-21-20	w =9.2 %				
									7.2	Bedrock, coarse white Feldspar Pegmatite overlying Mica (Biotite) Schist / Calcsilicate and Hornblende		
			R1		7.6-12.6	60/53	70					
	10											
300												
									12.6	Bottom of Exploration at 12.6 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 5

S.W.COLE ENGINEERING, INC.

BORING LOG

BORING NO.:	B- 6
SHEET:	1 of 1
PROJECT NO.	17-1017
DATE START:	3/20/2018
DATE FINISH:	3/20/2018

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

Drilling Information

LOCATION: See Exploration Location Plan | **ELEVATION (FT):** 318' +/- | **TOTAL DEPTH (FT):** 4.5 | **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC | **DRILLER:** Scott Hollabaugh | **DRILLING METHOD:** Hollow Stem Auger
RIG TYPE: Track Mounted Diedrich D-50 | **AUGER ID/OD:** 2 1/4 in / 5 5/8 in | **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic | **HAMMER WEIGHT (lbs):** 140 | **CASING ID/OD:** N/A /N/A | **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.87 | **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): Borehole caved- no groundwater readings
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION					Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data				
			1D		0-2	24/16	3-3-3-3			Forest Duff, topsoil and organics		
									0.5	Medium dense, brown Silty SAND		
315									4.0	Probable Weathered Bedrock		
									4.5	Refusal at 4.5 feet Probable Bedrock		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 6

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

BORING NO.: B- 7
SHEET: 1 of 1
PROJECT NO. 17-1017
DATE START: 3/20/2018
DATE FINISH: 3/20/2018

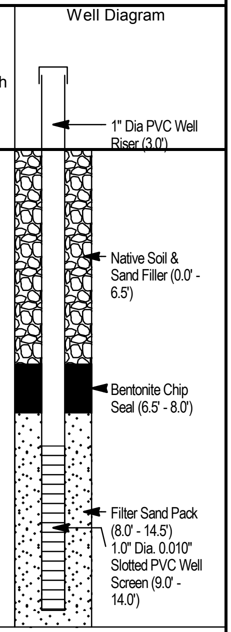
Drilling Information

LOCATION: See Exploration Location Plan
ELEVATION (FT): 311' +/-
TOTAL DEPTH (FT): 14.5
LOGGED BY: Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC
DRILLER: Scott Hollabaugh
DRILLING METHOD: Cased Boring
RIG TYPE: Track Mounted Diedrich D-50
AUGER ID/OD: N/A / N/A
SAMPLER: Standard Split-Spoon
HAMMER TYPE: Automatic
HAMMER WEIGHT (lbs): 140
CASING ID/OD: 4 in / 4 1/2 in
CORE BARREL: NQ2 / 2
HAMMER EFFICIENCY FACTOR: 0.87
HAMMER DROP (inch): 30
WATER LEVEL DEPTHS (ft): ▼ 7.4 ft 3/21/2018 Piezometer Installed
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
▽ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth
			1D		0-2	24/14	3-3-7-7		0.4	Forest Duff, topsoil and organics	
310										Medium dense, brown Gravelly SAND, some silt (Glacial Till)	
	5								4.9	Bedrock, Mica Schist / Calcsilicate and Hornblende with garnet, locally coarse	
305			R1		5.5-10.5	60/48	80	q_U=1450 ksf			▼
	10										
300			R2		10.5-14.5	48/58	79				
									14.5	Bottom of Exploration at 14.5 feet	

Well Diagram



Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 7

BORING LOG

BORING NO.:	B- 8
SHEET:	1 of 1
PROJECT NO.	17-1017
DATE START:	3/19/2018
DATE FINISH:	3/19/2018

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 310' +/- **TOTAL DEPTH (FT):** 20.1 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Scott Hollabaugh **DRILLING METHOD:** Hollow Stem Auger
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** 2 1/4 in / 5 5/8 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A /N/A **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.87 **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): ▼ 2.3 ft 3/20/2018 Borehole open to 4.6' +/-
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
▽ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
			1D		0-2	24/4	1-1-3-1			Forest Duff, topsoil and organics		
										1.0 Medium dense, brown Gravelly SAND, some silt (Glacial Till)	▼	
305	5		2D		5-6.4	17/12	12-23-50/5"					
300	10		3D		10-12	24/18	14-17-18-31					
295	15		3D		15-15.9	11/10	31-50/5"			15.0 Dense, brown Silty Gravelly SAND (Glacial Till)		
										18.0 Probable Weathered Bedrock		
290	20		MD		20-20.1	1/0	50/1"			20.1 Refusal at 20.1 feet Probable Bedrock		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 8

	BORING LOG	BORING NO.: B- 9
S.W.COLE ENGINEERING, INC.	CLIENT: Central Maine Power	SHEET: 1 of 1
	PROJECT: Proposed AC/DC Converter Substation	PROJECT NO. 17-1017
	LOCATION: Merrill Road, Lewiston, Maine	DATE START: 3/19/2018
		DATE FINISH: 3/20/2018

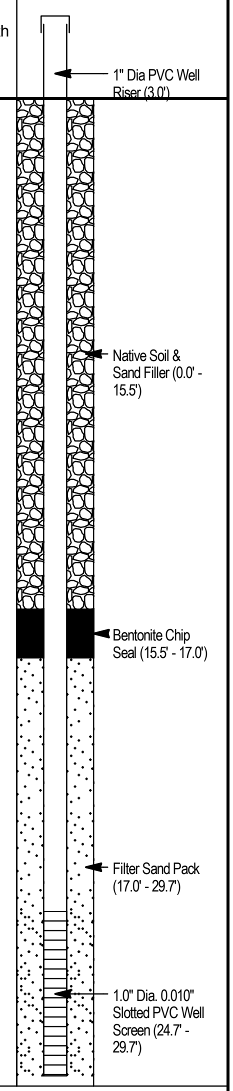
Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 339' +/- **TOTAL DEPTH (FT):** 30.0 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Scott Hollabaugh **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2
HAMMER EFFICIENCY FACTOR: 0.87 **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): ▼ 9.8 ft 3/21/2018 Piezometer Installed
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
▽ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth
			1D		0-2	24/15	1-1-2-6			Forest Duff, topsoil and organics	
									1.0	Medium dense, brown Silty SAND, some gravel	
335	5		R1		4-7.5	42/36	88		4.0	Bedrock, Mica Schist / Calcsilicate and Hornblende with garnet, locally coarse	
								q_U=940 ksf			
330	10		R2		7.5-12.5	60/66	85				▼
325	15		R3		12.5-16.4	47/46	63				
			R4		16.4-17.5	13/13	100				
320	20		R5		17.5-22.5	60/55	83				
315	25		R6		22.5-27.5	60/64	68				
310	30		R7		27.5-30	30/26	67		30.0	Bottom of Exploration at 30.0 feet	

Well Diagram



Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

BORING NO.: B-10
SHEET: 1 of 1
PROJECT NO. 17-1017
DATE START: 3/19/2018
DATE FINISH: 3/19/2018

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 333' +/- **TOTAL DEPTH (FT):** 11.5 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Scott Hollabaugh **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2
HAMMER EFFICIENCY FACTOR: 0.87 **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): 3.1 ft 3/20/2018 Borehole open to 3.8' +/-
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level: At time of Drilling; At Completion of Drilling; After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_U = Unconfined Compressive Strength, kips/sq.ft.; N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D		0-2	24/16	2-2-2-3		0.5	Forest Duff, topsoil and organics		
										Medium dense, reddish-brown Silty fine SAND, trace gravel		
330									3.0	Medium dense, brown Silty SAND, some gravel	▼	
	5		2D		5-6.3	15/14	15-18-50/3"	w =11 %				
			R1		6.5-11.5	60/60	100		6.2	Bedrock, Mica Schist / Calcsilicate and Hornblende with garnet, locally coarse		
325												
	10											
									11.5	Bottom of Exploration at 11.5 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

S.W.COLE ENGINEERING, INC.

BORING LOG

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

BORING NO.: B-11
SHEET: 1 of 1
PROJECT NO. 17-1017
DATE START: 3/19/2018
DATE FINISH: 3/19/2018

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 304' +/- **TOTAL DEPTH (FT):** 14.0 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Scott Hollabaugh **DRILLING METHOD:** Hollow Stem Auger
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** 2 1/4 in / 5 5/8 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** N/A /N/A **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.87 **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): Borehole caved - no groundwater readings
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
			1D		0-2	24/10	2-2-2-6			Forest Duff, topsoil and organics		
									1.5	Medium dense, brown Silty SAND, some gravel		
300	5		2D		5-7	24/18	11-10-10-11		5.0	Medium dense to dense, brown Gravelly SAND, some silt (Glacial Till)		
295	10		3D		10-12	24/19	19-43-16-28					
290									14.0	Refusal at 14.0 feet Probable Bedrock		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-11

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

BORING NO.: B-12
SHEET: 1 of 2
PROJECT NO. 17-1017
DATE START: 3/15/2018
DATE FINISH: 3/16/2018

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 378' +/- **TOTAL DEPTH (FT):** 60.4 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Scott Hollabaugh **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic **HAMMER WEIGHT (lbs):** 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2
HAMMER EFFICIENCY FACTOR: 0.87 **HAMMER DROP (inch):** 30
WATER LEVEL DEPTHS (ft): ⊻ 23.6 ft 3/21/2018 ▼ 29.6 ft 3/21/2018 Piezometer Installed
GENERAL NOTES: Water level at 29.6' in deep well and 23.6' in shallow well on 3-21-18

KEY TO NOTES AND SYMBOLS:
Water Level
⊻ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling

D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear

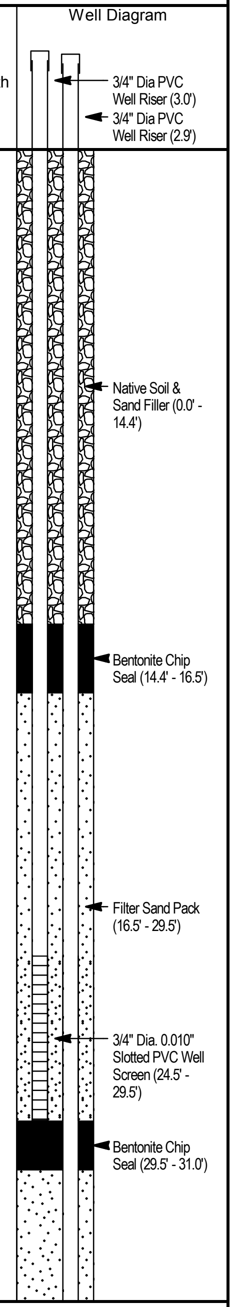
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot

WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector

S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Sample Depth (ft)	Pen./Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Sample Description & Classification	H_2O Depth
									1.0 Brown Silty SAND, some gravel	
375									3.5 Bedrock, Mica (Biotite) Hornblende Feldspar Schist - trace calcsilicate, locally pegmatitic with quartz and garnet, altered near oxidized fracture zones	
	5		R1		4.5-8	42/42	74			
370			R2		8-13	60/60	88			
	10									
365			R3		13-18	60/57	85			
	15									
360			R4		18-20	24/24	92			
	20		R5		20-23	36/36	100			
355			R6		23-28	60/61	87			⊻
	25									
350			R7		28-33	60/61	100			▼
	30									
345			R8		33-38	60/60	95			

Well Diagram



Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

BORING NO.: B-12

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

BORING NO.: B-12
SHEET: 2 of 2
PROJECT NO. 17-1017
DATE START: 3/15/2018
DATE FINISH: 3/16/2018

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Well Diagram
340			R9		38-43	60/60	100					Filter Sand Pack (31.0' - 46.0')
	40											
335			R10		43-48	60/60	93					
	45											
330			R11		48-53	60/60	100					Bentonite Chip Seal (46.0' - 48.5')
	50											
325			R12		53-57.8	57/57	100					
	55											Filter Sand Pack (48.5' - 60.4')
320			R13		57.8-60.4	31/31	100					3/4" Dia. 0.010" Slotted PVC Well Screen (55.4' - 60.4')
	60								60.4	Bottom of Exploration at 60.4 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-12

BORING LOG

BORING NO.: P- 1
SHEET: 1 of 1
PROJECT NO. 17-1017
DATE START: 3/19/2018
DATE FINISH: 3/19/2018

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 330' +/- **TOTAL DEPTH (FT):** 5.0 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Scott Hollabaugh **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:**
HAMMER TYPE: N/A **HAMMER WEIGHT (lbs):** N/A **CASING ID/OD:** N/A /N/A **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: **HAMMER DROP (inch):** N/A
WATER LEVEL DEPTHS (ft):
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
										Forest duff overlying probable glacial till soils		
									4.5	Probable Weathered Bedrock		
325	5								5.0	Refusal at 5.0 feet Probable Bedrock		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: P- 1

BORING LOG

S.W.COLE ENGINEERING, INC.

BORING NO.:	P- 2
SHEET:	1 of 1
PROJECT NO.	17-1017
DATE START:	3/19/2018
DATE FINISH:	3/19/2018

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 345' +/- **TOTAL DEPTH (FT):** 8.5 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Scott Hollabaugh **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:**
HAMMER TYPE: N/A **HAMMER WEIGHT (lbs):** N/A **CASING ID/OD:** N/A /N/A **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: **HAMMER DROP (inch):** N/A
WATER LEVEL DEPTHS (ft):
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
										Forest duff overlying probable glacial till soils		
340	5											
	7.5									Probable Weathered Bedrock		
	8.5									Refusal at 8.5 feet Probable Bedrock		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: P- 2

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power
PROJECT: Proposed AC/DC Converter Substation
LOCATION: Merrill Road, Lewiston, Maine

BORING NO.: P- 3
SHEET: 1 of 1
PROJECT NO. 17-1017
DATE START: 3/19/2018
DATE FINISH: 3/19/2018

Drilling Information

LOCATION: See Exploration Location Plan
ELEVATION (FT): 334' +/-
TOTAL DEPTH (FT): 8.5
LOGGED BY: Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC
DRILLER: Scott Hollabaugh
DRILLING METHOD: Solid Stem Auger
RIG TYPE: Track Mounted Diedrich D-50
AUGER ID/OD: N/A / 4 1/2 in
SAMPLER:
HAMMER TYPE: N/A
HAMMER WEIGHT (lbs): N/A
CASING ID/OD: N/A /N/A
CORE BARREL:
HAMMER EFFICIENCY FACTOR:
HAMMER DROP (inch): N/A
WATER LEVEL DEPTHS (ft):
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
										Forest duff overlying probable glacial till soils		
330												
	5								5.0	Probable Weathered Bedrock		
									8.5	Refusal at 8.5 feet Probable Bedrock		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: P- 3

S.W.COLE ENGINEERING, INC. • Geotechnical Engineering • Field & Lab Testing • Scientific & Environmental Consulting

KEY TO NOTES & SYMBOLS
Test Boring and Test Pit Explorations

All stratification lines represent the approximate boundary between soil types and the transition may be gradual.

Key to Symbols Used:

w	-	water content, percent (dry weight basis)
q_u	-	unconfined compressive strength, kips/sq. ft. - laboratory test
S_v	-	field vane shear strength, kips/sq. ft.
L_v	-	lab vane shear strength, kips/sq. ft.
q_p	-	unconfined compressive strength, kips/sq. ft. – pocket penetrometer test
O	-	organic content, percent (dry weight basis)
W_L	-	liquid limit - Atterberg test
W_P	-	plastic limit - Atterberg test
WOH	-	advance by weight of hammer
WOM	-	advance by weight of man
WOR	-	advance by weight of rods
HYD	-	advance by force of hydraulic piston on drill
RQD	-	Rock Quality Designator - an index of the quality of a rock mass.
γ_T	-	total soil weight
γ_B	-	buoyant soil weight

Description of Proportions:

Trace:	0 to 5%
Some:	5 to 12%
"Y"	12 to 35%
And	35+%
With	Undifferentiated

Description of Stratified Soils

Parting:	0 to 1/16" thickness
Seam:	1/16" to 1/2" thickness
Layer:	½" to 12" thickness
Varved:	Alternating seams or layers
Occasional:	one or less per foot of thickness
Frequent:	more than one per foot of thickness

REFUSAL: **Test Boring Explorations** - Refusal depth indicates that depth at which, in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

REFUSAL: **Test Pit Explorations** - Refusal depth indicates that depth at which sufficient resistance to the advance of the backhoe bucket was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

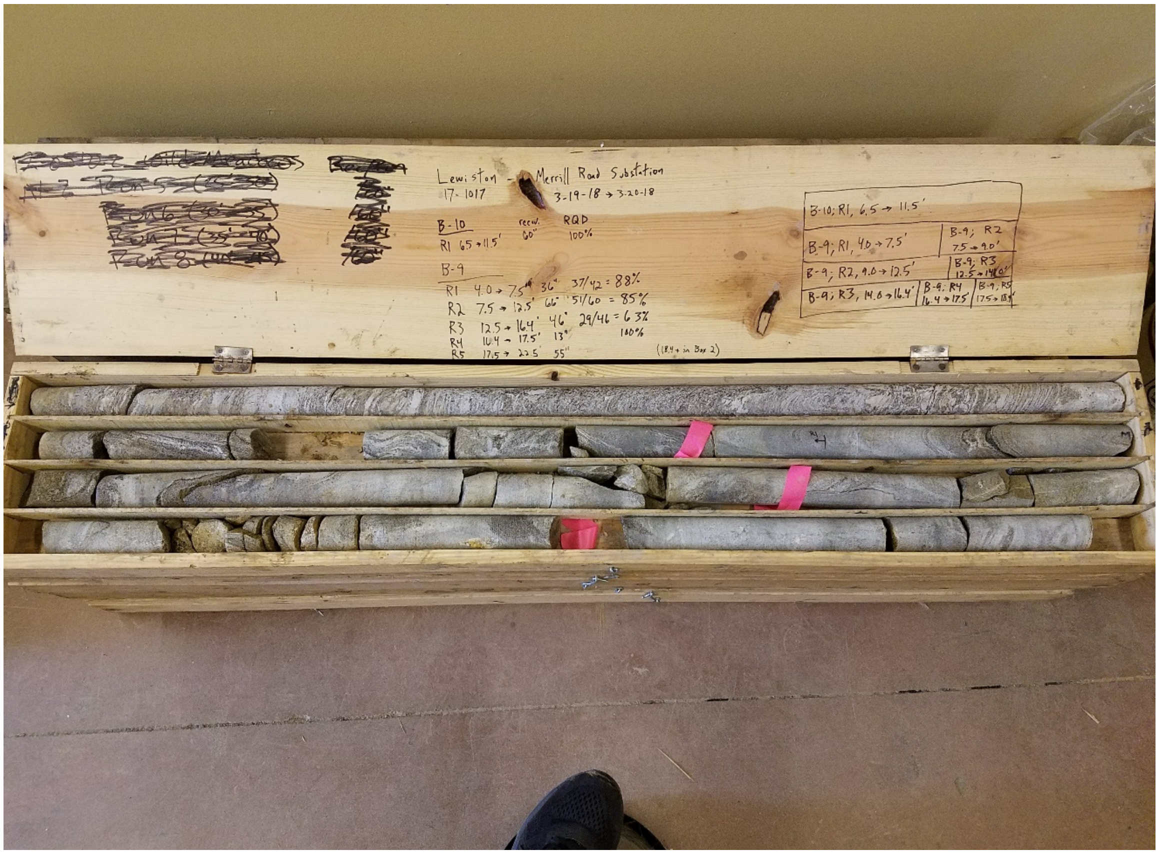
Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man-made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.

B-4, R-1

B-5, R-1 and
B-7, R-1 through R-2

B-9 (Box 1), R-1 through R-5

B-9 (Box 2), R-5 through R-7



B-10, R-1

B-12 (Box 1), R-1 through R-6

B-12 (Box 2), R-6 through R-9

B-12 (Box 3), R-9 through R-7

APPENDIX D

Laboratory Test Results

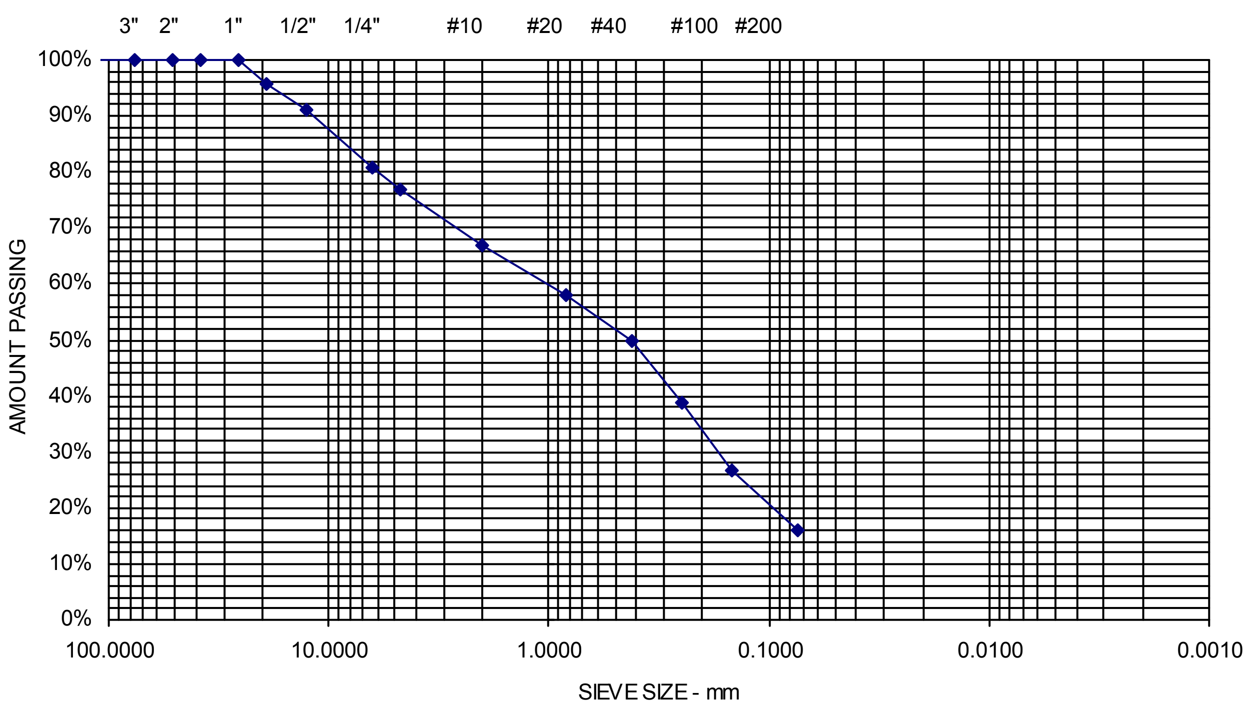
Report of Gradation

ASTM C-117 & C-136

Project Name	LEWISTON ME - MERRILL ROAD CMP SUBSTATION - GEOTECHNICAL ENGINEERING SERVICES	Project Number	17-1017
Client	CENTRAL MAINE POWER COMPANY	Lab ID	21428B
Exploration	**B-5, 5-7'**	Date Received	4/2/2018
Material Source	**2D**	Date Completed	4/3/2018
		Tested By	NICOLAS TRÉBOUET

STANDARD DESIGNATION (mm/µm)	SIEVE SIZE	AMOUNT PASSING (%)	
150	**6"**	**100**	
125	**5"**	**100**	
100	**4"**	**100**	
75	**3"**	**100**	
50	**2"**	**100**	
38.1	**1-1/2"**	**100**	
25.0	**1"**	**100**	
19.0	**3/4"**	**96**	
12.5	**1/2"**	**91**	
6.3	**1/4"**	**81**	
4.75	**No. 4**	**77**	23% Gravel
2.00	**No. 10**	**67**	
850	**No. 20**	**58**	
425	**No. 40**	**50**	61% Sand
250	**No. 60**	**39**	
150	**No. 100**	**27**	
75	**No. 200**	**16.0**	16% Fines

SILTY GRAVELLY SAND



Comments: W=9.2%

Sheet

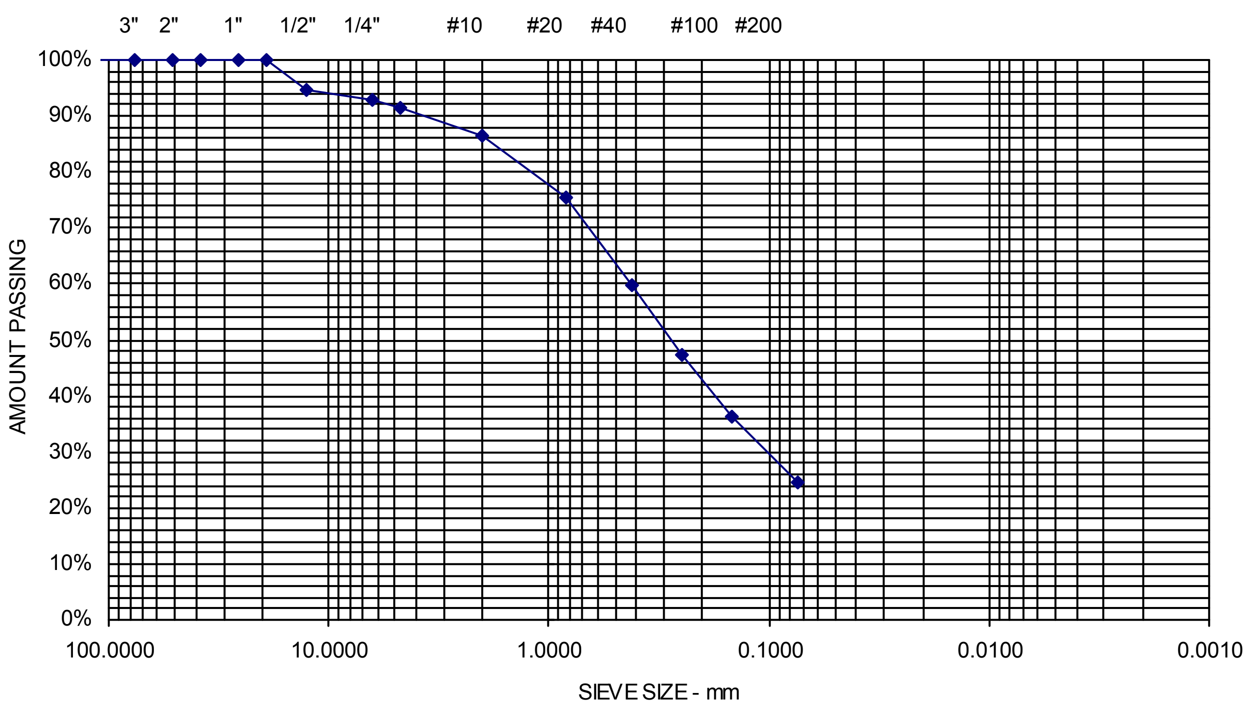
Report of Gradation

ASTM C-117 & C-136

Project Name	LEWISTON ME - MERRILL ROAD CMP SUBSTATION - GEOTECHNICAL ENGINEERING SERVICES	Project Number	17-1017
Client	CENTRAL MAINE POWER COMPANY	Lab ID	21429B
Exploration	**B-10, 5-6.2'**	Date Received	4/2/2018
Material Source	**2D**	Date Completed	4/3/2018
		Tested By	

STANDARD DESIGNATION (mm/µm)	SIEVE SIZE	AMOUNT PASSING (%)	
150	**6"**	**100**	
125	**5"**	**100**	
100	**4"**	**100**	
75	**3"**	**100**	
50	**2"**	**100**	
38.1	**1-1/2"**	**100**	
25.0	**1"**	**100**	
19.0	**3/4"**	**100**	
12.5	**1/2"**	**95**	
6.3	**1/4"**	**93**	
4.75	**No. 4**	**91**	8.6% Gravel
2.00	**No. 10**	**87**	
850	**No. 20**	**76**	
425	**No. 40**	**60**	66.8% Sand
250	**No. 60**	**47**	
150	**No. 100**	**36**	
75	**No. 200**	**24.6**	24.6% Fines

SILTY SAND, SOME GRAVEL



Comments: W=11%

Sheet

Exhibit G-2: Fickett Road Substation Class B High Intensity Soils Survey and Geotechnical Report

Class B High Intensity Soil Survey

For

Central Maine Power Company Proposed Substation

Fickett Rd. & Allen Rd.
Pownal, ME

Soil Survey completed by Robert Vile Soil Consulting Inc

June 19, 2017

Robert Vile
Licensed Site Evaluator
Certified Soil Scientist

P.O. Box 114, Cates Rd.
Dixmont, ME 04932

Telephone:
(207)234-2451

Date: June 19, 2017

To: Sackett & Brake Survey, Inc.
P.O. Box 207
Skowhegan, Me. 04976

Re: Class B High Intensity Soil Survey of a +- 10 acre parcel of land located off the Fickett and Allen roads in Pownal Maine for a Central Maine Power Company Quebec-Maine Interconnect Surdwiec Substation..

Findings: On June 2.and June 14, 2014 I investigated the above captioned parcel. The purpose of the investigation was to conduct a Class B High Intensity Soil of the property. Soils were described by backhoe excavated test pits to a depth of four feet and many soil auger borings throughout the parcel. The soil test pit locations as well as a two foot contour map at a scale of 1"=50' were provided by Sackett & Brake Survey, Inc. This soil survey was conducted for the use in the planning of a Central Maine Power Substation. This Class B High Intensity Soil Survey was mapped following these minimum standards described in Guidelines For Maine Certified Soil Scientists For Soil Identification And Mapping:
Class B (High Inttensity)

1. Map units will not contain dissimilar limiting individual inclusions larger than one acre. Dissimilar limiting inclusions may total more than one acre per map unit delineation, in the aggregate, if not continuous.
2. Scale of 1 inch equals 200 feet or larger.
3. Ground control-test pits for which detailed data is recorded are located by means of compass by chaining , pacing, or taping from known survey points; or other methods of equal or greater accuracy.
4. Base map with 5-foot contour lines.

Three Soil Series were identified on the parcel. Peru, Lamoine, and Scantic soil series. The Peru soils are classified as Coarse-loamy, isotic, frigid Aquic Hapllorthods by Soil Taxonomy. These soils are moderately well drained soils that formed in lodgment till on the upland portions of this parcel. Peru soils are deeper than 48" to bedrock These soils are found on two separate wooded knowls on this property with slopes ranging from 3 to 20%. Several huge boulders are common in these areas as well. Firm basil till was found between 20 to 30 inches below the mineral surface. Seasonal water table depths were found 17 to 24 inches below the surface . A typical pedon for this series is described at

Test Pit # 3. Please see attached test pit logs. Peru soils are a Class C Hydrologic Soil Group. Surface run-off is medium and permeability is moderate in the upper horizons and moderately slow in the lower horizons. There is very little hazard to flooding in the areas mapped Peru on this parcel. Inclusions within the mapping units may include the Tunbridge Soil Series which will have bedrock between 20 to 48 inches. Also Lamoine soils may be inclusions within the soil units mapped. The Peru soils will have a very little negative impact on the proposed development of a substation.

The Lamoine soils are classified as Fine, illitic, nonacid, frigid Aeric Epiaquepts by Soil Taxonomy. These soils are very deep, somewhat poorly drained soils formed in glaciolacustrine or glaciomarine deposits found on the flat to gently sloping portions of the property. Lamoine soils on this parcel have firm silt loam to silty clay sub horizons that occur between 14 to 20 inches below the mineral surface. A small portion of the Lamoine soils were found within the woodline but most occur in the dryer parts of the field area on this site. Seasonal water tables were observed in the test pits between 7 to 9 inches below the mineral surface. A typical pedon of the Lamoine series was described at test pit # 10. Please see attached test pit logs. Lamoine soils are a Class D Hydrologic Soil Group. Surface Run-off is medium and permeability is moderate or moderately slow in the surface horizon, moderately slow or slow in the upper part of the subsoil, and slow or very slow in the lower part of the subsoil. The Lamoine soils on this lot are found on 0-3% slopes. There is little hazard of flooding on the Lamoine soils. Inclusions within the map units may include the Scantic or Peru series. The Lamoine soils are not hydric soils however the high seasonal water table and silty clay subsoil are not optimum for development on this parcel.

The lower elevations and largest areas on the parcel were found to consist of the Scantic Soil Series. The Scantic soils are classified as Fine, illitic, nonacid, frigid Typic Epiaquepts by Soil Taxonomy. These soils are very deep , poorly drained soils formed in glaciomarine or glaciolacustrine deposits on the lowland / wetland portions of the property. The slopes that the Scantic soils were found on the lot were 0-3 %. These soils have silt loam upper horizons underlain by firm silty clay loam to silty clay subsoil. The seasonal water table is at the mineral surface and ponding of surface water was identified in a portion of the map unit. A typical pedon for this series was described at test pit # 5. Please see attached test pit logs. Scantic soils are hydric soils and usually associated with wetlands. This parcel was previously wetland delineated by another scientist. The Scantic soils are a Class D Hydrologic Soil Group. Surface Run-off slow on this parcel. Permeability is moderately slow in the upper horizons and slow in the lower horizons. Flooding is possible on the Scantic soils as standing water was evident the day of the investigation. Inclusions within the Scantic map unit is the Lamoine soil series. The poorly drained Scantic soils are not optimum for this development and may be associated with the wetlands on the parcel.

The accompanying soil profile descriptions , soil survey map and this soil narrative report dated June 19, 2017were done in accordance with the standards adopted by the Maine Association of Professional Soil Scientists and presented in the " Guidelines for Maine Certified Soil Scientists for Soil Identification and Mapping " latest revision and prepared by Robert G Vile jr. " Certified Soil Scientist # 201.

If you have any questions regarding the investigation or the soil survey please feel free to contact me at the above number.

Sincerely,

Robert G Vile jr

Robert G. Vile jr.
C.S.S. # 201
L.S.E. S204

STATE OF MAINE
Robert Vile
C.S.S. #201
CERTIFIED
SOIL SCIENTIST

FORM F 1/01

SOIL PROFILE / CLASSIFICATION INFORMATION

DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES

Project Name: Quebec – Maine Interconnect Surdwiec Substation
Applicant Name: Central Maine Power Co
Project Location (municipality): Fickett + Allen Rd. Pownal

Exploration Symbol: TP #1 ■ Test Pit ☐ Boring

0 " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–9	Silt Loam	Friable	Dark Brown	None
9–18			Light Olive Brown	Common Distinct
18–36	Silty Clay Loam	Firm	Light Olive Grey / Olive Grey	Many Prominent

Soil data by S.E.: Soil Profile 9; Classification Condition E; Slope ___ Percent; Limiting Factor 8 Depth; ■ Groundwater ☐ Restrictive Layer ☐ Bedrock

Soil data by S.S.: Soil series/phase name: Lamoine; ☐ Hydric ■ Non-hydric; Hydrologic Soil Group D

Exploration Symbol: TP # 2 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–20	Fine Sandy Loam	Friable	Dark Yellowish Brown / Yellowish Brown	None
20–36	Sandy Loam	Firm	Light Olive Brown	Common Distinct

Soil data by S.E.: Soil Profile 3; Classification Condition C; Slope ___ Percent; Limiting Factor 17 Depth; ■ Groundwater ☐ Restrictive Layer ☐ Bedrock

Soil data by S.S.: Soil series/phase name: Peru; ☐ Hydric ■ Non-hydric; Hydrologic Soil Group C

Exploration Symbol: TP #3 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–23	Fine Sandy Loam	Friable	Dark Yellowish Brown / Strong Brown / Yellowish Brown	None
23–40	Gravelly Sandy Loam	Firm	Light Olive Brown	Common Distinct
46	144" Refusal / possible Ledge			

Soil data by S.E.: Soil Profile 3; Classification Condition C/AIII; Slope ___ Percent; Limiting Factor 18 Depth; ● Groundwater ☐ Restrictive Layer ☐ Bedrock

Soil data by S.S.: Soil series/phase name: Peru; ☐ Hydric ■ Non-hydric; Hydrologic Soil Group C

Exploration Symbol: TP #4 ■ Test Pit ☐ Boring

0 " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–13	Silt Loam	Friable	Dark Brown	None
13–21			Light Olive Brown	Common Distinct
21–38	Silty Clay Loam	Firm	Olive Grey	Many Prominent

Soil data by S.E.: Soil Profile 9; Classification Condition D; Slope ___ Percent; Limiting Factor 9 Depth; ■ Groundwater ☐ Restrictive Layer ☐ Bedrock

Soil data by S.S.: Soil series/phase name: Lamoine; ☐ Hydric ■ Non-hydric; Hydrologic Soil Group

INVESTIGATOR INFORMATION AND SIGNATURE

Signature: Robert G Vile
Date: 6-17-17
Name Printed/typed: Robert G. Vile Jr.
Cert/Lic/Reg. # 201
Title: ■ Licensed Site Evaluator ☐ Certified Geologist ■ Certified Soil Scientist ☐ Other:

STATE OF MAINE
Robert Vile
C.S.S. #201
CERTIFIED SOIL SCIENTIST

affix professional seal

FORM F 1/01

SOIL PROFILE / CLASSIFICATION INFORMATION

DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES

Project Name: Quebec – Maine Interconnect Surdwicc Substation
Applicant Name: Central Maine Power Co
Project Location (municipality): Fickett + Allen Rd. Pownal

Exploration Symbol: T.P. #5 ■ Test Pit ☐ Boring

1 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–12	Silt Loam	Friable	Dark Greyish Brown	Common Distinct
12–24	Silty Clay Loam	Firm	Olive Gray	Many Prominent
24–36	Silty Clay	Very Firm	Light olive gray	

Soil data by S.E.: Soil Profile 9; Classification Condition E; Slope ____ Percent; Limiting Factor 0" Depth ■ Groundwater ☐ Restrictive Layer ☐ Bedrock

Soil data by S.S.: Soil series/phase name: Scantic; ■ Hydric ☐ Non-hydric; Hydrologic Soil Group D

Exploration Symbol: T.P. #6 ■ Test Pit ☐ Boring

1 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–8	Silt Loam	Friable	Dark Brown	None
8–15			Dark Greyish Brown	Common Distinct
15–24	Silty Clay Loam	Firm	Olive	Many Prominent
24–30	Silty Clay	Very Firm	Gray	

Soil data by S.E.: Soil Profile 9; Classification Condition E; Slope ____ Percent; Limiting Factor 6" Depth ■ Groundwater ☐ Restrictive Layer ☐ Bedrock

Soil data by S.S.: Soil series/phase name: Scantic; ■ Hydric ☐ Non-hydric; Hydrologic Soil Group D

Exploration Symbol: T.P. #7 ■ Test Pit ☐ Boring

0 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–9	Silt Loam	Friable	Brown	None
9–15			Light olive Brown	Common Distinct
15–27	Silty Clay Loam	Firm	Light olive gray	Many Prominent
27–38	Silty Clay	Very Firm	Olive Gray	

Soil data by S.E.: Soil Profile 9; Classification Condition E; Slope ____ Percent; Limiting Factor 7" Depth ■ Groundwater ☐ Restrictive Layer ☐ Bedrock

Soil data by S.S.: Soil series/phase name: Lamoine; ☐ Hydric ■ Non-hydric; Hydrologic Soil Group D

Exploration Symbol: T.P. #8 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–11	Fine Sandy Loam	Friable	Dark Yellowish Brown	
11–26			Yellowish Brown	None
26–32				
32–44	Gravely Sandy Loam	Firm	Light olive Brown	Common Faint

Soil data by S.E.: Soil Profile 3; Classification Condition C; Slope ____ Percent; Limiting Factor 24" Depth ■ Groundwater ☐ Restrictive Layer ☐ Bedrock

Soil data by S.S.: Soil series/phase name: Peru; ☐ Hydric ■ Non-hydric; Hydrologic Soil Group ____

INVESTIGATOR INFORMATION AND SIGNATURE

Signature: Robert G. Vile jr.
Date: 6-17-17
Name Printed/typed: Robert G. Vile jr.
Cert/Lic/Reg. # 201
Title: ■ Licensed Site Evaluator ☐ Certified Geologist ■ Certified Soil Scientist ☐ Other:

STATE OF MAINE
Robert Vile
C.S.S. #201
CERTIFIED SOIL SCIENTIST

affix professional seal

FORM F 1/01

SOIL PROFILE / CLASSIFICATION INFORMATION

DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES

Project Name: Quebec – Maine Interconnect Surdwicc Substation
Applicant Name: Central Maine Power Co
Project Location (municipality): Fickett + Allen Rd. Pownal

Exploration Symbol: T.P. #9 ■ Test Pit ☐ Boring

0 " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–12	Silty Loam	Friable	Dark Grayish Brown	None
12–24	Silty Clay Loam	Firm	Light olive gray	Common Distinct / many Prominent
24–36	Silty Clay	Very Firm	olive gray	

soil data by S.E.	Soil 9 Profile; Classification E Condition; Slope ___ Percent	Limiting Factor 5 Depth; ■ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: Scantic; ■ Hydric ☐ Non-hydric	Hydrologic D Soil Group

Exploration Symbol: T.P. #10 ■ Test Pit ☐ Boring

0 " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–14	Silty Loam	Friable	Dark Brown	None
14–26	Silty Clay Loam	Firm	Light olive Brown / olive gray	Common Distinct / many prominent
26–36	Silty Clay	Very Firm		

soil data by S.E.	Soil 9 Profile; Classification D Condition; Slope ___ Percent	Limiting Factor 9 Depth; ■ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: Lamoine; ☐ Hydric ■ Non-hydric	Hydrologic D Soil Group

Exploration Symbol: T.P. #11 ■ Test Pit ☐ Boring

0 " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–12	Silt Loam	Friable	Dark Brown / Light olive Brown	None / Common Distinct
12–21	Silty Clay Loam	Firm	Light olive gray	many Prominent
21–30	Silty Clay	Very Firm	olive gray	

soil data by S.E.	Soil 9 Profile; Classification E Condition; Slope ___ Percent	Limiting Factor 3 Depth; ■ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: Scantic; ■ Hydric ☐ Non-hydric	Hydrologic D Soil Group

Exploration Symbol: ______ ☐ Test Pit ☐ Boring

____ " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–48				

soil data by S.E.	Soil ___ Profile; Classification ___ Condition; Slope ___ Percent	Limiting Factor ___ Depth; ☐ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: ______; ☐ Hydric ☐ Non-hydric	Hydrologic ___ Soil Group

INVESTIGATOR INFORMATION AND SIGNATURE

Signature: Robert G Vile Jr.   Date: 6-17-17

Name Printed/typed: Robert G. Vile Jr.   Cert/Lic/Reg. # 201

Title: ■ Licensed Site Evaluator ☐ Certified Geologist ■ Certified Soil Scientist ☐ Other:

STATE OF MAINE Robert Vile C.S.S. #201 CERTIFIED SOIL SCIENTIST

affix professional seal

LOCATION PERU NH+MA ME NY VT

Established Series
Rev. HRM-RFL-DHZ
06/2016

PERU SERIES

The Peru series consists of moderately well drained soils that formed in loamy lodgment till on hills and mountains in glaciated uplands. They are moderately deep to a dense substratum and very deep to bedrock. Estimated saturated hydraulic conductivity is moderately high or high in the solum, and moderately low or moderately high in the dense substratum. Slope ranges from 0 to 60 percent. Mean annual precipitation is about 1180 mm, and mean annual temperature is about 6 degrees C.

TAXONOMIC CLASS: Coarse-loamy, isotic, frigid Aquic Haplorthods

TYPICAL PEDON: Peru fine sandy loam, on a north facing, 15 percent slope in a very stony wooded area. (Colors are for moist soil unless otherwise noted.)

Oe--0 to 3 cm; black (10YR 2/1) moderately decomposed plant material; very friable; very strongly acid (pH 4.9); abrupt smooth boundary. (O horizon thickness is 0 to 10 cm.)

A--3 to 13 cm; dark brown (7.5YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many very fine and fine and few coarse roots; 5 percent rock fragments; very strongly acid (pH 4.8); abrupt wavy boundary. (0 to 10 cm thick)

E--13 to 15 cm; light brownish gray (10YR 6/2) fine sandy loam; weak medium granular structure; friable; common fine roots; 5 percent rock fragments; very strongly acid (pH 4.8); abrupt broken boundary. (0 to 10 cm thick)

Bs1--15 to 18 cm; dark brown (7.5YR 3/4) fine sandy loam; weak fine granular structure; friable; common fine and few coarse roots; 5 percent rock fragments; very strongly acid (pH 5.0); abrupt broken boundary.

Bs2--18 to 33 cm; strong brown (7.5YR 4/6) fine sandy loam; weak fine granular structure; friable; common fine and few coarse roots; 5 percent rock fragments; very strongly acid (pH 5.0); clear wavy boundary.

Bs3--33 to 46 cm; dark yellowish brown (10YR 4/6) fine sandy loam; weak medium subangular blocky structure; friable; common fine roots; 5 percent rock fragments; strongly acid (pH 5.2); abrupt wavy boundary. (Combined thickness of the Bs horizon is 7 to 38 cm).

BC--46 to 54 cm; dark yellowish brown (10YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; few fine roots; common fine faint olive brown (2.5Y 4/3) iron depletions in the matrix; 5 percent rock

fragments; strongly acid (pH 5.2); abrupt smooth boundary. (0 to 38 cm thick)

Cd1--54 to 94 cm: olive brown (2.5Y 4/3) fine sandy loam; 85 percent moderate medium plates and 15 percent sandy lenses; firm; common medium faint olive gray (5Y 4/2) iron depletions in the matrix; 5 percent rock fragments; strongly acid (pH 5.2); clear wavy boundary.

Cd2--94 to 165 cm; olive gray (5Y 4/2) fine sandy loam; 95 percent moderate thick plates and 5 percent sandy lenses; firm; common medium faint olive brown (2.5Y 4/3) masses of iron accumulation on faces of peds; 5 percent rock fragments; strongly acid (pH 5.2).

TYPE LOCATION: Merrimack County, New Hampshire; Town of New London; located about 275 meters west of County Road on Northwood Lane, and 35 meters south of the road; USGS Sunapee Lake North, NH topographic quadrangle; latitude 43 degrees 24 minutes 04 seconds N. and longitude 72 degrees 01 minutes 17 seconds W., NAD 83.

RANGE IN CHARACTERISTICS: The thickness of the mineral solum and depth to densic materials from the mineral surface range from 50 to 100 cm. Depth to bedrock is greater than 150 cm. Texture is typically fine sandy loam, sandy loam, or loam in the fine-earth fraction but includes silt loam and very fine sandy loam in the upper part of the solum. The weighted average of clay in the particle-size control section is 10 percent or less. The silt content in the solum and underlying till averages less than 50 percent, but ranges to 50 percent or more in the upper 25 cm of the solum. Rock fragments are dominantly gravel with some cobbles and stones and typically range from 5 to 30 percent throughout the mineral soil. Some pedons have horizons with less than 5 percent rock fragments. Reaction ranges from extremely acid to slightly acid in the solum, and from very strongly acid to slightly acid in the substratum.

The O horizons, where present, consist of slightly, moderately, and/or highly decomposed organic material. The Oe and Oa horizons have hue of 2.5YR to 10YR, value of 2 to 4, and chroma of 1 to 4.

The A, or Ap horizon where present, has hue of 5YR to 10YR and value and chroma of 2 to 4.

The E horizon is neutral or has hue of 5YR to 2.5Y, value of 4 to 7, and chroma of 0 to 2.

The Bhs horizon, where present, is up to 13 cm thick and has hue of 2.5YR to 10YR, a value of 2 to 3, and a chroma of 1 to 3.

The Bs horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 3 to 8.

The BC horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 2 to 6.

Some pedons have an E or E' horizon below the B horizon. It has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 or 3. Typically, it has a coarser texture than the overlying horizon.

Some pedons have a friable C horizon up to 20 cm thick that has color and texture similar to the underlying Cd horizon.

The Cd horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 2 to 4. Consistence is firm or very firm. Arrangement of soil particles into plates is considered to be geogenic. Loose or fri ble segregated sand lenses with a horizontal orientation compose up to 20 percent of the densic materials. The lenses are typically coarse, medium, or fine sand ranging from 2 to 25 mm thick.

COMPETING SERIES: These are the Chesuncook, Crary, Dixmont, Howland, Ragmuff, Skerry, Sunapee, and Worden series. Chesuncook soils have a weighted average of more than 10 percent clay in the particle-size control section. Crary soils have a mantle of eolian or water deposited sediments ranging from 40 to 100 cm thick over till. Dixmont and Sunapee soils are formed in loamy supraglacial till and do not have densic materials within 100 cm of the mineral soil surface. Howland soils have a weighted average of more than 50 percent silt in the particle-size control section. Ragmuff soils are moderately deep to bedrock. Skerry soils have more than 20% sandy lenses in the Cd horizon. Worden soils are somewhat poorly drained.

GEOGRAPHIC SETTING: Peru soils are on nearly level to steep slopes in glaciated uplands. Typically they are on linear or convex areas of backslopes, footslopes, and toeslopes, but they also occur in concave positions. The soils formed in loamy lodgment till derived mainly from schist, gneiss, phyllite, and granite. Slope ranges from 0 to 60 percent. The mean annual precipitation is 790 to 1640 mm, and the mean annual temperature is 2 to 7 degrees C. The frost-free period ranges from 90 to 160 days. Elevation ranges from about 2 to 800 meters above sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Berkshire, Brayton, Cabot, Colonel, Lyman, Marlow, Monadnock, Peacham, Pillsbury, Sunapee, and Tunbridge soils. Berkshire, Lyman, Monadnock, Sunapee, and Tunbridge soils are formed in supraglacial till and do not have densic materials. Additionally, Lyman soils are shallow to bedrockk, and Tunbridge soils are moderately deep to bedrock. Peru soils are in a drainage sequence with the well drained Marlow soils, somewhat poorly drained Colonel soils, poorly drained Brayton, Cabot, and Pillsbury soils, and very poorly drained Peacham soils.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Moderately well drained. Estimated saturated hydraulic conductivity is moderately high or high in the solum, and moderately low or moderately high in the dense substratum.

USE AND VEGETATION: Most areas are wooded. The common trees are sugar maple, eastern white pine, balsam fir, red spruce, white spruce, white ash, yellow birch, paper birch, eastern hemlock, American beech, and red pine. Areas cleared of stones are used mainly for hay and pasture and some cultivated crops.

DISTRIBUTION AND EXTENT: Maine, Massachusetts, New Hampshire, New York, and Vermont. The soils of this series are extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Berkshire County, Massachusetts, 1923.

REMARKS: 1. Dixfield soils were recorrelated to Peru soils as part of the national Soil Data Join Recorrelation initiative. Revisions to the Peru Range in Characteristics incorporate values from the Dixfield Official Series Description. As a result of this revision to Peru, the Dixfield series status has been changed to

inactive.

2. Diagnostic horizons and features recognized in this pedon are:

a. Ochric epipedon - the zone from 0 to 15 cm (Oe, A, and E horizons).
b. Spodic horizon - the zone from 15 to 33 cm (Bs1 and Bs2 horizons).
c. Aquic conditions - redoximorphic features at 43 cm below the mineral soil surface (BC, Cd1, and Cd2 horizons).
d. Densic materials - the zone from 54 to 165 cm (Cd1 and Cd2 horizons).

ADDITIONAL DATA: Characterization data for Peru and similar soils is available through the National Cooperative Soil Survey Soil Characterization Database: http://ncsslabdatamart.sc.egov.usda.gov/

National Cooperative Soil Survey
U.S.A.

LOCATION LAMOINE ME+MA VT

Established Series
Rev. GBJ-PAH-WDH-NRB
04/2016

LAMOINE SERIES

The Lamoine series consists of very deep, somewhat poorly drained soils formed in glaciolacustrine or glaciomarine deposits on coastal lowlands and river valleys. Slope ranges from 0 to 15 percent. Permeability is moderate or moderately slow in the surface horizon, moderately slow or slow in the upper part of the subsoil, and slow or very slow in the lower part of the subsoil and in the substratum. Mean annual temperature is about 7 degrees C, and mean annual precipitation is about 1118 mm at the type location.

TAXONOMIC CLASS: Fine, illitic, nonacid, frigid Aeric Epiaquepts

TYPICAL PEDON: Lamoine silt loam, on a 3 percent slope in an abandoned hayfield. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 18 cm; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; moderate fine granular structure; friable; many very fine and common fine roots; moderately acid; abrupt smooth boundary. (13 to 31 cm thick)

Bw1--18 to 23 cm; light olive brown (2.5Y 5/4) silt loam; weak fine granular structure; friable; many very fine and few fine roots; few fine prominent light olive gray (5Y 6/2) iron depletions, and common fine and medium distinct olive (5Y 5/3) and common medium prominent yellowish brown (10YR 5/6) masses of iron accumulation; moderately acid; abrupt wavy boundary.

Bw2--23 to 30 cm; light yellowish brown (2.5Y 6/4) silt loam; weak very fine subangular blocky structure; friable; many very fine roots; common fine prominent yellowish red (5YR 5/6) masses of iron accumulation, and common medium prominent light olive gray (5Y 6/2) iron depletions; olive (5Y 5/3) faces of peds; moderately acid; abrupt wavy boundary.

Bw3--30 to 43 cm; light olive brown (2.5Y 5/4) silty clay loam; moderate very fine and fine subangular blocky structure; firm; common very fine roots between peds; few medium prominent yellowish red (5YR 5/6) masses of iron accumulation, and common medium prominent gray (5Y 6/1) and many coarse prominent light olive gray (5Y 6/2) iron depletions; light olive gray (5Y 6/2) faces of peds; few prominent dark reddish brown (5YR 2/2) manganese coats on faces of peds; moderately acid; clear wavy boundary. (Combined thickness of the Bw horizons is 23 to 71 cm.)

BCg--43 to 53 cm; olive (5Y 4/3) silty clay loam; strong very coarse prismatic structure parting to weak thin and medium platy; firm; few very fine roots between peds; common medium faint olive gray (5Y 5/2) iron manganese coats on faces of peds within prisms; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulations associated with the manganese coats; neutral; gradual wavy boundary.

Cg2--81 to 127 cm; olive (5Y 5/3) silty clay; weak thin platy structure; firm; common coarse distinct gray (5Y 5/1) iron depletions and common coarse prominent yellowish brown (10YR 5/6) masses of iron accumulation; olive gray (5Y 5/2) faces of peds; many prominent black (5YR 2/1) manganese coats on faces of peds; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulations associated with the manganese coats; neutral; diffuse wavy boundary.

Cg3--127 to 165 cm; olive (5Y 5/3) silty clay; weak thin platy structure; firm; common medium faint olive gray (5Y 5/2) iron depletions; olive (5Y 4/3) faces of peds; many prominent black (5YR 2/1) manganese coats on faces of peds; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulations associated with the manganese coats; neutral.

TYPE LOCATION: Hancock County, Maine; City of Ellsworth; west of Union River, 1,300 feet north of junction of U.S. Route 1A and Gilpatrick Brook, in an abandoned hayfield between a gravel road and the railroad track; USGS Ellsworth topographic quadrangle; lat. 44 degrees 34 minutes 25 seconds N. and long. 68 degrees 27 minutes and 24 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 41 to 140 cm. Depth to bedrock is more than 152 cm. Rock fragment content throughout the soil is less than 5 percent by volume. Stones cover from 0 to 3 percent of the surface. Reaction ranges from very strongly acid to slightly acid in the surface, unless limed, from strongly acid to neutral in the subsoil, and from moderately acid to neutral in the substratum.

Some pedons have an O horizon.

The Ap horizon has hue of 10YR or 2.5Y, with value and chroma of 2 to 4. Undisturbed areas have an A horizon 3 to 15 cm thick, that has hue of 10YR or 2.5Y, value of 2 to 4 and chroma of 1 to 4. They are silt loam or silty clay loam. They have moderate or strong, very fine to medium granular structure. Consistence is very friable or friable.

The B horizon has hue of 10YR to 5Y, value of 3 to 7 and chroma of 2 to 6. It is silt loam, silty clay loam, or silty clay. It has weak to strong, fine or medium granular, very fine to coarse subangular blocky, or medium or thick platy structure, or has primary structure that is coarse or very coarse prismatic. Consistence is friable or firm.

The BC horizon has hue of 2.5Y or 5Y, value of 4 to 6 and chroma of 1 to 4. It is silt loam, silty clay loam or silty clay. It has blocky or platy structure or has primary structure that is prismatic. Consistence is firm or very firm.

The C horizon has hue of 2.5Y or 5Y or is neutral, value of 3 to 6 and chroma of 1 to 4. It is silty clay loam, silty clay, or clay. It has blocky, platy, or prismatic structure, all of which are considered inherited, or the horizon is massive. Consistence is firm or very firm. Common or many black to dark reddish brown oxide coats are on faces of peds. Some pedons have films on faces of peds that appear to be fine silt.

COMPETING SERIES: There are currently no other series in the same family. The Roundabout, Swanton and Swanville series are similar soils in related families. Roundabout soils have a coarse-silty particle-size class. Swanton soils have a coarse-loamy over clayey particle-size class, and Swanville soils have a fine-silty particle-size class.

GEOGRAPHIC SETTING: Lamoine soils are on coastal lowlands and river valleys. Slope ranges from 0 to 15 percent. The soils formed in medium, moderately fine and fine textured glaciolacustrine or glaciomarine sediments. The climate is humid and cool temperate. The mean annual precipitation ranges from 864 to 1219 mm, and mean annual temperature ranges from 6 to 8 degrees C. The frost-free season ranges from 90 to 160 days. Elevation ranges from 2 to 274 meters above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Biddeford, Boothbay, Buxton, Scantic, and Swanville soils. The very poorly drained Biddeford soils are in depressions on the landscape. The moderately well or somewhat poorly drained Boothbay soils are in similar and higher positions on the landscape and have a fine-silty particle-size class. The moderately well drained Buxton soils are in higher positions on the landscape. The poorly drained Scantic and Swanville soils are in lower positions on the landscape.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat poorly drained. Surface runoff is medium. Saturated hydraulic conductivity is moderately high in the surface horizon, moderately low to moderately high throughout the remainder of the solum, and low to moderately low in the substratum.

USE AND VEGETATION: Cleared areas are used mainly for hay or pasture. The remaining areas are forested. Common tree species include eastern white pine, balsam fir, red spruce, white spruce, eastern hemlock, red maple, yellow birch, gray birch, paper birch, sugar maple, alders and aspen.

DISTRIBUTION AND EXTENT: Maine and Vermont. (MLRAs 142, 143, 144A, 144B and 145) The series is of large extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Hancock County, Maine, 1988.

REMARKS: 1. This revision reflects a change in classification from Aeric Haplaquepts to Aeric Epiaquepts to conform with Keys to Taxonomy, sixth edition, 1994.
2. Some soils formerly mapped as Buxton will now be included with the Lamoine series.
3. Some pedons have been described with a bisequum profile.
4. Diagnostic horizons and features recognized in this pedon are:

a. Ochric epipedon - the zone from 0 to 18 cm (Ap horizon).
b. Cambic horizon - the zone from 18 to 43 cm (Bw1, Bw2, and Bw3 horizons).
c. Aeric feature - matrix with chroma of 3 or more between the A or Ap horizon and 76 cm.
d. Aquic conditions-Redoximorphic features at 18 cm.
e. Episaturation - a perched water table.

ADDITIONAL DATA: Soil interpretation record numbers for the Lamoine series are: Lamoine, ME0108; Lamoine, stony, ME0130.

National Cooperative Soil Survey
U.S.A.

LOCATION SCANTIC ME+MA NH NY VT

Established Series
Rev. KJL-GBJ-WDH
06/2016

SCANTIC SERIES

The Scantic series consists of very deep, poorly drained soils formed in glaciomarine or glaciolacustrine deposits on coastal lowlands and river valleys. Slope ranges from 0 to 8 percent. Saturated hydraulic conductivity of the surface and subsurface horizons is moderately high or high and low or moderately slow in the subsoil and substratum. Mean annual temperature is about 7 degrees C, and mean annual precipitation is about 1168 mm inches at the type location.

TAXONOMIC CLASS: Fine, illitic, nonacid, frigid Typic Epiaquepts

TYPICAL PEDON: Scantic silt loam, on a 1 percent slope in an idle field. (Colors are for moist soil unless otherwise noted.)

Ap1--0 to 10 cm; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak very fine granular structure; very friable; many very fine, fine, medium and coarse roots; moderately acid; abrupt smooth boundary.

Ap2--10 to 23 cm; dark grayish brown (2.5Y 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; moderate very fine granular structure; very friable; common very fine, fine, medium and coarse roots; common medium distinct olive gray (5Y 5/2) irregularly shaped iron depletions throughout; moderately acid; abrupt wavy boundary. (Combined thickness of the Ap horizons is 13 to 23 cm.)

Eg--23 to 28 cm; olive gray (5Y 5/2) silt loam; weak medium platy structure parting to weak very fine subangular blocky; friable; common very fine, fine, medium and coarse roots; common medium prominent light olive brown (2.5Y 5/6) masses of iron accumulation in the matrix and along root channels; moderately acid; abrupt smooth boundary. (0 to 20 cm thick)

Bg1--28 to 41 cm; olive gray (5Y 5/2) silty clay loam; moderate thin platy structure; firm; common very fine, fine, and medium and few coarse roots; common medium prominent yellowish brown (10YR 5/6) masses of iron accumulation in the matrix and along pores; many coarse prominent olive brown (2.5Y 4/4) masses of iron accumulation in the matrix and along pores; common medium faint gray (5Y 6/1) irregularly shaped iron depletions in the matrix; light olive gray (5Y 6/2) silt coatings on walls of earthworm channels and on 50 percent of faces of peds; few medium dark gray (5Y 4/1) oxide coats on faces of peds; slightly acid; clear wavy boundary.

Bg2--41 to 56 cm; olive gray (5Y 5/2) silty clay; weak medium platy structure parting to moderate very fine subangular blocky; firm; few very fine and fine roots; few pores; common medium faint gray (5Y 6/1) irregularly shaped iron depletions in the matrix; common medium prominent light olive brown (2.5Y 5/4) masses of iron accumulation in the matrix and along pores; light olive gray (5Y 6/2) silt coatings on walls of earthworm channels and on 50 percent of faces of peds; few fine prominent dark reddish brown (5YR 2/2) oxide coats on faces of peds; slightly acid; gradual wavy boundary.

Bg3--56 to 74 cm; olive gray (5Y 4/2) silty clay; moderate very fine and fine subangular blocky structure; firm; few pores; common medium prominent light olive brown (2.5Y 5/6) masses of iron accumulation in the matrix and along pores; common medium faint olive gray (5Y 5/2) irregularly shaped iron depletions in the matrix; gray (5Y 6/1) silt coatings on 50 percent of faces of peds and pores; common medium prominent dark reddish brown (5YR 2/2) oxide coats on 10 percent of faces of peds; slightly acid; clear wavy boundary. (Combined thickness of the Bg horizon is 23 to 89 cm.)

Cg--74 to 1165 cm; olive gray (5Y 4/2) clay; weak thick platy structure; firm; few medium prominent light olive brown (2.5Y 5/6) masses of iron accumulation in the matrix; few fine faint gray (5Y 5/1) irregularly shaped iron depletions in the matrix; gray (5Y 6/1) silt coatings on 50 percent of faces of peds; many medium prominent dark reddish brown (5YR 2/2) oxide coats on 30 percent of faces of peds; slightly acid.

TYPE LOCATION: Washington County, Maine; Town of Whitneyville; 0.25 mile south of railroad track on U.S. Route 1A, and 200 feet northwest of the road; USGS Whitneyville topographic quadrangle; lat. 44 degrees 42 minutes 34 seconds N. and long. 67 degrees 31 minutes 29 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 63 to 127 cm. Depth to bedrock is more than 152 cm. The soil is commonly free of rock fragments but a few pedons contain up to 3 percent gravel. Stones cover from 0 to 3 percent of the surface. Reaction ranges from very strongly acid to slightly acid in the surface and subsurface horizons, unless limed, and from strongly acid to neutral in the upper part of the subsoil. The reaction in the lower part of the subsoil and in the substratum is moderately acid to neutral.

In undisturbed areas some pedons have an O horizon that ranges from 3 to 18 cm thick that is neutral or has a hue of 5YR to 10YR, value of 2 to 3 and a chroma of 0 to 2. It is muck or mucky peat.

The Ap horizon has hue of 10YR to 5Y, value of 3 to 5 and chroma of 1 or 2. It has weak or moderate, very fine to coarse granular structure. Undisturbed areas have an A horizon 5 to 13 cm thick, that has hue of 10YR, value of 3 and chroma of 1 or 2. It is silt loam, silty clay loam, or loam. Consistence is very friable or friable.

The Eg horizon, has hue of 2.5Y or 5Y, value of 4 or 5 and chroma of 1 or 2 and few or common redoximorphic features. It has weak or moderate, thin to thick platy, fine or medium granular or very fine subangular blocky structure. It is silt loam, silty clay loam, or loam. Consistence is very friable or friable.

The Bg horizon has hue of 2.5Y or 5Y, value of 4 to 6 and chroma of 1 or 2 and has faint to prominent redoximorphic features. It is silt loam, silty clay loam, or silty clay. It has subangular blocky or platy structure but some pedons have primary structure that is prismatic. Consistence is friable or firm.

The BCg horizon, where present, has hue of 2.5Y or 5Y, or 5BG value of 4 to 6 and chroma of 1 or 2 with faint to prominent redoximorphic features. It is silty clay loam, silty clay, or clay. It has platy or angular blocky are less common or lacking in those from lacustrine deposits.

COMPETING SERIES: There are currently no other series in the same family. The Lamoine, [illegible], and [illegible] series are similar soils in related families. Lamoine soils have dominant chroma of 3 or more between the A or Ap horizon and 76 cm below the mineral soil surface. Swanton soils have a coarse-loamy over clayey particle-size class. Swanville soils have less clay in the particle-size control section.

GEOGRAPHIC SETTING: Scantic soils are on coastal lowlands and river valleys. Slope ranges from 0 to 8 percent. The soils formed in medium, moderately fine and fine textured glaciomarine or glaciolacustrine deposits. The climate is humid and cool temperate. Mean annual temperature ranges from about 6 to almost 8 degrees C , and mean annual precipitation ranges from 863 to 1219 mm. The frost-free season ranges from 90 to 160 days. Elevation ranges from about 2 to 275 m above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Biddeford, Buxton, Elmwood, Lamoine, Melrose, Swanton, and Whately soils. The Biddeford, Buxton and Lamoine soils are members of a drainage sequence with Scantic soils on the same landscape, Buxton and Lamoine soils are in higher positions and Biddeford soils are in depressions. The Elmwood, Melrose, Swanton and Whately soils all have a coarse-loamy over clayey particle-size class. Elmwood and Melrose soils are in higher positions on the landscape. Swanton soils are in similar positions and Whately soils are in depressions.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Poorly drained. Surface runoff is slow. Saturated hydraulic conductivity of the surface and subsurface horizons is moderately high or high and low or moderately slow in the subsoil and substratum.

USE AND VEGETATION: Mostly idle or woodland, some areas are used for growing hay and pasture. Common tree species include red maple, elm, gray birch, white ash, balsam fir, red and white spruce, tamarack, and some eastern white pine.

DISTRIBUTION AND EXTENT: MLRAs 142, 143, and 144B in Maine, Massachusetts, New Hampshire, New York, and Vermont. The series is of large extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Penobscot County, Maine, 1947.

REMARKS: Previous revisions reflect a change in classification from Typic Haplaquepts to conform with Keys To Soil Taxonomy, sixth edition, 1994. Historic correlations of Scantic may have occurred in presumed or isolated frigid areas in MLRAs 144A and 145.

Diagnostic horizons and features recognized in this pedon are:

1. Ochric epipedon - the zone from 0 to 28 cm (Ap and Eg horizons).
2. Cambic horizon - the zone from 28 to 89 cm (Bg horizon).
3. Nonacid - the pH is 5.0 or more in 0.01M calcium chloride in at least some part of the control section (25 to 100 cm).
4. Aquic conditions - redoximorphic features at 10 cm.
5. Episaturation - a perched water table.

ADDITIONAL DATA: Source of data used in establishing taxonomic class and range in characteristics is Maine Agricultural Experiment Station, Technical Bulletin 94, September 1979.
Soil interpretation record numbers for the Scantic series are: Scantic, ME0044; Scantic, stony, ME0062.

National Cooperative Soil Survey
U.S.A.

ROBERT VILE SOIL CONSULTING, INC.
P.O. BOX 114 DIXMONT, MAINE 04932

CLASS B HIGH INTENSITY SOIL SURVEY

FOR:

CENTRAL MAINE POWER COMPANY

QUEBEC – MAINE INTERCONNECT
SUROWIEC SUBSTATION

LOCATION: FICKETT ROAD and ALLEN ROAD
POWNAL, CUMBERLAND COUNTY, MAINE

FIELD SURVEY: ROBERT VILE	JUNE 19, 2017
CERTIFIED SOIL SCIENTIST #201	SCALE 1"=50'

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.

LEGEND

● = 3/4" IRON REBAR SET WITH RED PLASTIC CAP INSCRIBED S.W. GOULD PLS 2318 (unless otherwise noted).

= INTERMEDIATE CONTOUR (NAVD88 FEET)

300 = INDEX CONTOUR (NAVD88 FEET)

NOTES

NOTE...1 BOUNDARY SURVEY AND TOPOGRAPHIC INFORMATION PROVIDED BY SACKETT & BRAKE SURVEY, INC.

SOILS LEGEND

Sc – Scantic Series – Poorly Drained
Lm – Lamoine Series – Somewhat Poorly Drained
Pr – Peru Series – Moderately Well Drained

Slope Phases

A : 0% TO 3% Slope
B : 3% to 8% Slope
C : 8% to 15% Slope
D : 15% to 25% Slope
: Soil Test Pit
: Soil Boundary

Sc/A
Soil Series / Slope Phase

STATE OF MAINE
Robert Vile C.S.S. #201
CERTIFIED SOIL SCIENTIST

ROBERT VILE
CSS#201

2017085-SOILS

REPORT

17-1016 S

June 19, 2018

Explorations and Geotechnical Engineering Services

Proposed Substation
Fickett Road
Pownal, Maine

Prepared For:
Central Maine Power
Attention: Gerry Mirabile
83 Edison Drive
Augusta, Maine 04336

Prepared By:
S. W. Cole Engineering, Inc.
286 Portland road
Gray, Maine 04039
T: 207-657-2866

S.W.COLE ENGINEERING, INC.

- Geotechnical Engineering
- Construction Materials Testing and Special Inspections
- GeoEnvironmental Services
- Test Boring Explorations

www.swcole.com

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17-1016 S

June 19, 2018

Central Maine Power
Attention: Gerry Mirabile
Manager of Environmental Projects
83 Edison Drive
Augusta, ME 04336

Subject: Explorations and Geotechnical Engineering Services
Proposed Substation
Fickett Road
Pownal, Maine

Dear Gerry:

In accordance with our Revised Proposal, dated March 12, 2018, we have performed subsurface explorations for the subject project. This report summarizes our findings and geotechnical recommendations and its contents are subject to the limitations set forth in Appendix A.

1.0 INTRODUCTION

1.1 Scope and Purpose

The purpose of our services was to obtain subsurface information at the site in order to develop geotechnical recommendations relative to foundations and earthwork associated with the proposed construction. Our scope of services included test boring explorations, laboratory testing, a geotechnical analysis of the subsurface findings and preparation of this report.

1.2 Site and Proposed Construction

The proposed substation site is located in the southwesterly quadrant of the intersection of Fickett and Allen Roads in Pownal, Maine. We understand the proposed substation will be on the order of 580 by 280 feet in plan dimensions and will likely include new structures (transformers, dead-end, switchgear and steel pole structures). We understand spread footings and deep foundations are being considered for foundation support. Based on the information shown on the site plan dated March 6, 2018, prepared by Power Engineers, and our recent conversations, we understand the westerly side of the substation will have smaller surface equipment founded on concrete pads. The easterly side will have larger structures, including one or two A-frame or H-frame structures. Proposed equipment locations and structural loads are not available at this time. Existing grades vary from about elevation 195 to 179 feet within the proposed substation. We understand the proposed yard finish grade will be about elevation 183 feet requiring cuts and fills approaching about 12 and 4 feet, respectively.

Proposed and existing site features are shown on the “Exploration Location Plan” attached in Appendix B.

2.0 EXPLORATION AND TESTING

2.1 Explorations

Thirteen test borings (B-1 through B-9A, B-9B, and B-10 through B-12) were made at the site on April 20 through 25, 2018 by S. W. Cole Explorations, LLC. The exploration locations were selected by Power Engineers and established in the field by S. W. Cole Engineering, Inc. (S.W.COLE) using GPS measurements. The approximate exploration locations are shown on the “Exploration Location Plan” attached in Appendix B. Logs of the explorations and a key to the notes and symbols used on the logs are attached in Appendix C. The elevations shown on the logs were estimated based on topographic information shown on the “Exploration Location Plan”.

2.2 Field Testing

The test borings were drilled using a combination of hollow stem auger and cased wash-boring techniques. The soils were sampled at 2 to 5 foot intervals using a split spoon sampler and Standard Penetration Testing (SPT) methods. Pocket Penetrometer Tests (PPT) were performed where stiffer cohesive soils were encountered. Shelby tube sampling was performed where softer cohesive soils were encountered. Several Vane Shear Tests (VST) were attempted at the site, but there was no vane rotation due to sand layering in the clays. Upon encountering refusal in borings B-4, B-7, B-8 and B-9B were advanced into bedrock using an NQ2 rock core. SPT blow counts and PPT results are shown on the logs.

2.3 Laboratory Testing

2.3.1 Soil And Rock Testing

Soil and rock core samples obtained from the explorations were returned to our laboratory for further classification and testing. Atterberg Limits, moisture content and unconfined compression test results on clay and rock samples are noted on the logs. The results of soil gradation and one-dimensional laboratory consolidation testing are attached in Appendix D.

2.3.2 Laboratory Soil Chemistry Testing

Two soil samples from the upper few feet of soil at the test boring explorations were submitted to Katahdin Analytical Services (Katahdin) for determination of pH (SW9045), water soluble chloride content (EPA 325.2) and water soluble sulfate content (EPA 375.4) testing. The results of the pH, water soluble chloride and sulfate testing as well as sulfate exposure classifications in accordance with ACI 318 Table 4.2.1 are included in Appendix D and shown in the following table:

Exploration & Location	pH Testing (SW9045)	Chloride Testing (EPA 325.2)	Sulfate Testing (EPA375.4))	Sulfate Exposure Classification (ACI 318 Table 4.2.1)
B-5, 1-D	6.4	2600 ppm	1200 ppm	Moderate
B-8, 1-D	7.1	1200 ppm	4300 ppm	Severe

PQL – Procedure Quantification Limit
For chloride testing the PQL is 22 ppm and sulfate testing the PQL is 11 ppm.

3.0 SUBSURFACE CONDITIONS

3.1 Soil and Bedrock

In general, the test borings encountered a soils profile generally consisting of topsoil overlying clayey silt overlying a glaciomarine deposit of silty clay overlying granular soils (glacial till) overlying refusal surfaces (bedrock or probable bedrock). A surficial zone of fill and/or disturbed soil was encountered at boring B-10. The principal strata encountered are summarized below; refer to the attached logs for more detailed descriptions of the subsurface findings.

Fill: Boring B-10 encountered about 3 feet of loose sandy silt, some clay and gravel (fill) at the surface.

Topsoil: The topsoil varied from about 6 to 12 inches in thickness at the boring locations. Much of the site has been utilized as an agricultural field. Thus, thicker areas of topsoil/disturbed soil should be expected.

<u>Clayey Silt</u>: Where encountered below the topsoil, the explorations generally encountered a 1 to 1.5 foot thick layer of loose gray clayey silt with some rootlets and organics. This layer may be a previously tilled zone.

<u>Glaciomarine Deposits</u>: With the exception of borings B-1, B-3, B-9A and B-9B, the explorations encountered silty clay below the clayey silt. The silty clay transitioned generally from hard brown silty clay to medium to soft gray silty clay at a depth varying from about 8.5 to 10 feet below the existing ground surface. The medium to soft gray silty clay extends to depths varying from about 11 to 19 feet below the ground surface, where penetrated. Based on the laboratory consolidation testing at boring B-7, the softer gray silty clay deposit appears to be over consolidated by about 1 to 1.5 ksf with an OCR of about 2. In-situ vane shear testing was attempted in the softer gray silty clay, but the drillers could not turn the shear vanes, likely due to sand layers in the silty clay. The gray silty clay at boring B-8 appears stiffer based on laboratory consolidation testing.

<u>Glacial Till</u>: Medium dense granular soil generally consisting of silty gravelly sand was encountered below the marine deposit. The glacial till thickness varied from about 2 to 6 feet at the explorations. The glacial till may also contain some boulders.

<u>Refusal</u>: Where encountered, refusal surfaces (bedrock or probable bedrock) varied from about 3 to 24 feet below the existing ground surface. Rock was cored with an NQ2 (2-in) core bit at borings B-4, B-7, B-8 and B-9B. Based on the recovered rock core at these explorations, the bedrock is classified as Granite with RQD's (Rock Quality Designation) varying from about 53 to 100. Photos of the recovered rock core are attached in Appendix C.

Not all the strata were encountered at each exploration; refer to the attached logs for more detailed subsurface information.

3.2 Groundwater

The soils encountered at the test borings were moist to wet from the ground surface. Saturated soils were encountered at depths varying from at or near the ground surface to about 5 feet. Groundwater likely becomes perched on the relatively impervious silty clay and bedrock underlying the site. Long term groundwater information is not available. It should be anticipated that groundwater levels will fluctuate, particularly in response to periods of snowmelt and precipitation, as well as changes in site use.

3.3 General Geologic Conditions

3.3.1 General Geological Conditions

The Maine Geological Survey (MGS) *Surficial Geologic Map of Maine* (Thompson and Borns, 1985) and the *Surficial Geologic Map of The North Pownal Quadrangle, Maine*[1] (Marvinney, C.L., 1999) indicate the surficial geology of the Proposed Fickett Road Substation Project area consists of silty to gravelly near-shore marine sand deposits with glacial till deposits to the west and several small wetland deposits near the proposed substation location. A bedrock outcrop was observed while at the site, adjacent to Fickett Road, near boring B-3.

The MGS *Bedrock Geologic Map of Maine*[2] (Osberg et al., 1985) interprets the bedrock in the region to be muscovite-alkali feldspar Granite. Based on the mapped bedrock geology, acid producing bedrock is not interpreted to be present. The observed rock core is generally consistent with the published geologic mapping.

3.3.2 Seismic – Faulting Data

Seismic activity can impact a site from two sources: ground rupture directly beneath a site or shaking produced at the site from nearby seismic activity. There are no documented cases of ground rupture that can be definitely attributed to seismic activity in New England since the departure of glaciers more than 10,000 years ago. Bedrock deformation has occurred over geologic time, however evidence of faulting in the project area is limited to inferred faults associated with bedrock contacts and observed healed angular bedrock conglomerate and wacke observed in the core.

3.3.3 Seismic and Frost Conditions

According to IBC 2015/ASCE 7, we interpret the following Seismic Site Classes using the N-Value method for soil:

- Seismic Site Class B (for foundations on sound bedrock)
- Seismic Site Class E (for foundations on compacted fill over native soil)

We recommend the following seismic design parameters for the 2,500-year design earthquake:

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[1] Thompson, W. B. and Borns, H. B., eds., 1985, Surficial Geologic Map of Maine, Maine Geological Survey.
[2] Osberg, P. H., Hussey, A. M. , and Boone, G. M., eds., 1985, Bedrock Geologic Map of Maine, Maine Geological Survey.

RECOMMENDED SEISMIC DESIGN PARAMETERS (2,500-year Design Earthquake)		
Peak Ground Acceleration (PGA)	0.2-second Spectral Acceleration (S_S)	1-second Spectral Acceleration (S_1)
0.186	0.249g	0.081g

NOTE: Seismic design parameters from USGS accessed April 12, 2018. (https://earthquake.usgs.gov/designmaps/us/application.php)

Liquefiable soils typically consist of loose, fine sands and non-plastic silts below the groundwater table. Based on the subsurface findings, it is our opinion the soils at the site are not susceptible to liquefaction during a seismic event and therefore the risk of lateral spread and seismic induced settlement are negligible.

The 100-year Air Freezing Index for the Pownal, Maine area is about 1,500 Fahrenheit degree days, which corresponds to a frost penetration depth on the order of 5.0 feet. We recommend foundations exposed to freezing be covered with at least 5.0 feet of soil for frost protection.

4.0 EVALUATION AND RECOMMENDATIONS

4.1 General Findings

Based on the subsurface findings, the proposed construction appears feasible from a geotechnical standpoint. The principle geotechnical considerations include:

- Spread footing foundations and a slab-on-grade floors bearing on properly prepared subgrades appear suitable for proposed lightweight equipment foundations and control/switchgear buildings. Footings should bear on at least 12-inches of compacted Crushed Stone wrapped in geotextile fabric overlying undisturbed native non-organic soils or compacted fill. On-grade floor slabs for heated buildings should bear on at least 12-inches of properly compacted Structural Fill overlying properly prepared subgrades. Unheated structures should bear on at least 5 feet of compacted Structural fill or be underlain with rigid subgrade insulation.

- Foundations for heavy structures and foundations with overturning moments will need to be founded on bedrock and/or socketed into bedrock.

- All topsoil, fill, soils containing organics and loose or disturbed soil must be completely removed from beneath the proposed areas of construction and backfilled with properly compacted Structural Fill.

- Subgrades across the site will consist of sensitive silts and clays. Earthwork and grading activities should occur during drier, non-freezing weather of Spring, Summer and Fall. Rubber tired construction equipment should not operate directly on the native silt and clays when wet. Excavation of bearing surfaces should be completed with a smooth-edged bucket to lessen subgrade disturbance.

- The soil chloride and sulfate test results from near surface soils as noted above are higher than typically seen in native soils. The higher values reported may be due to agricultural practices at the site. The foundation engineer will need to assess the test results in foundation design. Additionally, the foundations should not be in contact with the native soils. It is not known how deep the higher values exist in the soil profile.

4.2 Settlement, Stability and Liquefaction Evaluations

The soft gray silty clay underlying the site is compressible under new loading from the proposed site fills and foundation loads. We have estimated post-construction settlement due to consolidation of the silty clay considering the following:

- The findings at the test borings;
- The results of the one-dimensional consolidation testing performed on samples of the gray silty clay obtained from borings B-7 and B-8;
- The existing and proposed site grading shown on the "Exploration Location Plan" and a finish yard elevation of 183 feet; and
- A soil bearing capacity of 3.0 ksf, or less.

Proposed equipment pad locations and loads are not available at this time. For preliminary planning, we have made an estimate of the post construction settlement due to consolidation of the underlying silty clay soils based on a finish yard elevation of 183 and a typical 10 by 10 foot square equipment foundation. We estimate that post-construction settlement may approach 1.5 inch total and 1 inch differential across the substation pad. The magnitude of post construction settlement will vary across the site due to varying foundation loads and varying compressible silty clay thickness. To help reduce post-construction settlement, we recommend fill needed to achieve subgrade elevation be placed as soon as practicable prior to placing foundations.

4.2 Site and Subgrade Preparation

We recommend that site preparation begin with the construction of an erosion control system to protect adjacent drainage ways and areas outside the construction limits. Surficial organics, roots and topsoil should be completely removed from areas of proposed fill and construction. As much vegetation as possible should remain outside the construction areas to lessen the potential for erosion and site disturbance.

Based on the subsurface findings, the thickness of topsoil and organics and forest duff varies from about 6 to 12 inches. The contractor should anticipate areas where the soil is disturbed and/or roots and soils containing organics may extend several feet below the ground surface in some areas. The methods used by the contractor for removal and the moisture condition of the site will affect the volume of material removal required. Topsoil and organics may be stockpiled and screened for reuse as a new topsoil layer in landscape areas. Suitability of the topsoil re-use from a nutrient and fertility standpoint should be evaluated by soil testing prior to its use.

4.3 Excavation and Dewatering

4.3.1 Excavations

Excavation work will generally encounter forest duff and topsoil, clayey silt and silty clay soils, some fills and bedrock. Care must be exercised during construction to limit disturbance of the bearing soils. Earthwork and grading activities should occur during drier, non-freezing weather of Spring, Summer and Fall. Rubber tired construction equipment should not operate directly on the native silt and clays. Low ground pressure tracked equipment will be needed and temporary haul roads overlying geotextile fabric may be necessary. Final cuts to subgrade should be performed with a smooth-edged bucket to help reduce strength loss from soil disturbance. Should subgrades become disturbed, the subgrade should be over-excavated to expose suitable soil and replaced with compacted Structural Fill or Crushed Stone and be compacted. A woven geotextile fabric may be needed at subgrade elevation prior to placing new fills if the soils are soft and wet.

Based on the proposed grading and subsurface conditions, some bedrock removal may be needed to achieve the required subgrade elevations, particularly in the areas of borings B-1, B-3, B-9A and B-9B. Bedrock removal will likely require drilling and blasting techniques. We recommend a licensed blasting contractor be engaged for bedrock removal. Pre-blast surveys should be completed on surrounding structures (including interior walls), water supply wells and infrastructure within 500 feet of the site prior to commencing blasting activities. Vibrations due to blasting should be monitored during construction. In addition, we recommend the subcontractor submit a detailed drilling and blasting plan with qualifications and references prior to blasting.

Temporary, unsupported soil excavations should be sloped back to 1½(H):1(V) or flatter. In all cases, excavations must be properly shored and/or sloped according to OSHA regulations to prevent sloughing and caving of the sidewalls during construction.

4.3.2 Dewatering

Sumping and pumping and the use of temporary diversion ditching dewatering techniques should be adequate to control water inflow into excavations above the groundwater table. Controlling the water levels to at least one foot below planned excavation depths will help stabilize subgrades during construction.

4.4 Embankment Construction

The proposed topographic information shown on the plan indicates fill soil slopes for the substation pad will generally be constructed with slopes of 3(H):1(V) or flatter and cut slopes will generally be constructed with slopes of 3(H):1(V) or flatter.

4.4.1 General

Fill slopes should be constructed as level benches, which are overbuilt to facilitate compaction. The final slope face should be constructed by cutting back into the compacted core prior to placing slope surface materials. Fill slopes constructed on existing terrain steeper than 3(H):1(V) should be keyed into the existing ground surface with continuous level benches. Fill slopes constructed on existing slopes flatter than 3(H):1(V) do not need continuous benching. We recommend a 10 foot wide and 1-foot thick drainage blanket be placed on native, non-organic soil beneath the toe of fill slopes prior to placing new fills. The drainage blanket should consist of Gravel Borrow or Structural and be placed on non-woven geotextile fabric and day-lighted for gravity drainage.

4.4.2 Fill Slopes 2(H):1(V) or Flatter

Fill materials needed to construct fill slopes at inclinations of 2(H):1(V) or flatter should consist of compacted Gravel Borrow or Structural Fill. Exposed soil slopes will be susceptible to surface erosion, slumping and sloughing, particularly during heavy rain and freeze/thaw events. Exposed slopes should be surfaced with an erosion control blanket and loam and seed, as soon as practicable, to create a vegetated mat. In areas of concentrated surface water, we recommend 8-inch minus rip-rap overlying a geotextile fabric be used in lieu of the erosion blanket and loam and seed.

4.4.3 Cut Slopes 2(H): 1(V) or Flatter

We recommend proposed soil cut slopes less than 15 feet in height consider slope inclinations of 2H: 1V or flatter. Cut slopes in bedrock should be sloped back to a stable condition, which will depend on rock fracturing, as well as bedrock formation strike and dip in relation to slope orientation. We recommend a representative from S.W.COLE observe the bedrock slopes during construction.

We recommend a minimum 5-foot wide bench be constructed at the interface of the overburden soil and bedrock to reduce potential erosion that could cause soils, cobbles and boulders to wash down the rock slopes potentially clogging drainage swales and causing blocking hazards.

In areas of concentrated surface water or locations of groundwater seeps, rip-rap should be used in lieu of the erosion blanket and loam/seed. We recommend cross-slope stone lined drainage channels underlain with geotextile fabric be constructed into the slope when the height of the slope exceeds 25 feet.

4.4.4 Slope Surface Erosion Control

Unprotected and un-established slopes, regardless of inclination, will be susceptible to surface erosion, slumping, and sloughing especially during precipitations and freeze/thaw events. Topsoil and seed should be installed, as soon as practicable, to create a vegetated mat over the entire surface of the slope. We recommend the use of UV resistant synthetic erosion control mesh to reinforce the surface soils until the vegetated mat is established, particularly if constructed during the winter or spring seasons.

4.5 Foundations

4.5.1 Building and Equipment Foundations:

We recommend proposed building foundations be supported on spread footings founded on at least 12-inches of compacted Crushed Stone fully wrapped with a non-woven geotextile fabric such as Mirafi 180N overlying undisturbed stiff native soils or compacted Gravel Borrow. Non-moment-carrying equipment foundations and lightweight equipment pads should be founded on at least 12-inches of compacted Structural Fill or Crushed Stone overlying at least 4 feet of compacted Gravel Borrow or Structural Fill. For foundations bearing on properly prepared subgrades, we recommend the following geotechnical parameters for design consideration:

GEOTECHNICAL PARAMETERS	
Net Allowable Soil Bearing Pressure	3.0 ksf or less (Spread Footings and Mat Foundations on compacted fill or Crushed Stone)
Net Allowable Bedrock Bearing Pressure	15.0 ksf (Clean, sound, intact bedrock)
Design Frost Depth of Footings on Soil	5.0 ft min
Design Frost Depth for Footings Pinned to Sound Bedrock Depth	2.5 ft min
Base Friction Factor	0.35 (Mass concrete to structural fill)
Base Friction Factor	0.45 (Mass concrete to bedrock)
Passive Lateral Earth Pressure Coeff. (K_p)	3.0 (compacted Structural Fill)
Equivalent Fluid Pressure (Passive)	390 psf/ft (compacted Structural Fill)
Active Lateral Earth Pressure Coeff. (K_a)	0.3 (compacted Structural Fill)
Equivalent Fluid Pressure (Active)	40 psf/ft (compacted Structural Fill)
At-Rest Lateral Earth Pressure Coeff. (K_o)	0.5 (compacted Structural Fill)
Equivalent Fluid Pressure (At-Rest)	60 psf/ft (compacted Structural Fill)
Total Unit Weight of Backfill (γ_t)	125 pcf (compacted Structural Fill)
Internal Friction Angle (Φ)	32 degrees (compacted Structural Fill)

Spread footings should be at least 24 inches in width regardless of the bearing pressure. We understand all foundations and concrete structures and slabs will be designed by others. Foundations and backfill will need to be designed for buoyancy at the existing ground surface if deeper drainage is not achievable.

4.5.2 Rock Anchorage:

Based on the subsurface conditions and guidance from the Post-Tensioning Institute's manual entitled *Recommendations for Prestressed Rock and Soil Anchors* (PTI, 2004), we recommend the use of prestressed, Class I corrosion protection, grouted rock anchors be considered by the foundation designer where rock anchors are being considered. We recommend the following geotechnical parameters for preliminary rock anchor design consideration:

GEOTECHNICAL PARAMETERS FOR ROCK ANCHORS	
RQD of Rock Core (see boring logs)	55 to 100%
Average Dry Unit Weight of Bedrock Samples	160 pcf
Rock Cone Pull-Out Angle (from vertical)	45 degrees (from vertical)
Average Ultimate Grout to Bedrock Bond Strength	120 psi

The bonded length will depend upon the uplift load and the diameter of the drill hole. Rock anchor spacing should be at least 1.2 times the free-stressing length; closer spacing will reduce allowable anchor loads. Rock anchors installed in groups should be designed with consideration of pullout resistance from overlapping failure surfaces extending from the midpoint of the anchor bond zone to the bedrock surface.

The drill-hole for each rock anchor should be cleaned of any drilling fines and tightness tested to determine the need for pre-grouting. Rock anchors should be installed, tested and locked-off according to the design engineer's recommendations.

4.5.3 Foundations Bearing On Bedrock

We anticipate A-Frame and/or H-frame structures will be constructed within the easterly portion of the proposed substation. Structural loads and actual equipment locations are not known at this time. Based on the findings at the explorations, depths to bedrock may vary from a few feet to about 25 feet below the existing ground surface at the site.

Depending upon anticipated structural loads, we anticipate A-Frame and/or H-frame foundations will need to derive support from the underlying bedrock. Depending upon the location, the foundation could consist of a large mat foundation bearing on and pinned to bedrock, or if rock is deep, drilled shafts socketed into bedrock. Soft, weathered bedrock, if encountered, should be removed. An allowable bearing contact pressure of 15.0 ksf or less should be considered for sound, intact bedrock. A concrete leveling mat may be placed on the prepared bedrock surface prior to placing reinforced concrete foundations. The foundation should be anchored to the bedrock if the rock is sloping steeper than 3(H):1(V) and/or if structural loads dictate. The leveling mat should extend beyond the footing edges or piers by at least 24 inches. Rock anchors extending into bedrock will likely be needed to provide uplift capacity for the A-Frame and/or H-frame pier foundations. We understand foundation type and design will be by the project structural engineer.

4.5.4 Foundations On Drilled Shafts

The proposed A-frame and/or H-frame structures may be supported on drilled shafts socketed into bedrock. Drilled shafts should be socketed at least 2 feet into competent bedrock. Deeper rock sockets may be required depending on the load requirements.

The base of the rock sockets should be leveled and cleaned of loose material and soil. We recommend deep foundations be drilled using steel casing within the overburden soils in order to maintain sidewall stability. Prior to installing reinforcing steel, S.W.COLE should observe the base of each drilled foundation. Temporary steel casings should be removed during concrete placement while maintaining a positive head of concrete above the casing bottom to maintain shaft sidewall stability.

Considering the subsurface conditions encountered, we anticipate drilled shaft axial capacity will be controlled by the concrete compressive strength. We recommend an allowable end-bearing pressure of 15 ksf utilizing a factor of safety of 2.0. For piers socketed deeper than two feet, additional axial compressive capacity can be mobilized from skin friction between the pier and rock socket. For a design concrete strength of 4,000 psi, a unit skin friction of 15 ksf can be considered for he portion of the pier socketed greater than 2 feet into rock.

Uplift resistance of drilled shafts can be developed from skin friction between the drilled shaft and soil and bedrock, as well as the dead weight of the drilled shaft. The top 2 feet of soil and rock should not be included in design uplift capacity. S.W.COLE can assist with uplift capacities as deemed necessary by the structural engineer.

Lateral loads may be resisted from earth pressures acting on the sides of shafts, grade beams and pile caps backfilled with compacted Gravel Borrow or Structural Fill considering a total unit weight of granular backfill (γt) of 125 pcf, an angle of internal friction of 30 degrees with an at-rest lateral earth pressure coefficient (Ko) of 0.5. Additional resistance to lateral loads can be mobilized along the pile shafts, if needed. S.W.COLE can assist with lateral capacities using L-Pile, as deemed necessary by the structural engineer.

4.6 Foundation Drainage

We recommend an underdrain system be installed on the outside edge of the perimeter of building structures with spread footings. The underdrain pipe should consist of 4-inch diameter, perforated SDR-35 foundation drain pipe bedded in Crushed Stone and covered with non-woven geotextile fabric. The underdrain pipe must have a positive gravity outlet protected from freezing, clogging and backflow. Surface grades should be sloped away from the building and other structures for positive surface water drainage. We anticipate there will be a perimeter drainage swale around the substation yard to help drain new fills. We anticipate the groundwater at the site is at or near the existing ground surface seasonally and during periods of heavy precipitation and/or snowmelt. Thus, it appears gravity drainage may be difficult to achieve, depending upon final yard grade elevation and depths to bottom of foundations. Where foundations extend below the existing ground surface elevation and are not provided with foundation drainage, we recommend foundations be designed for buoyancy considering a groundwater table at about existing ground elevation and a submerged backfill unit weight of 58 pcf.

4.7 Slab-On-Grade

On-grade floor slabs in heated areas may be designed using a subgrade reaction modulus of 120 pci (pounds per cubic inch) provided the slab is underlain by at least 12-inches of compacted Structural Fill placed over properly prepared subgrades. The structural engineer or concrete consultant must design steel reinforcing and joint spacing appropriate to slab thickness and function.

We recommend a sub-slab vapor retarder particularly in areas of the building where the concrete slab will be covered with an impermeable surface treatment or floor covering that may be sensitive to moisture vapors. The vapor retarder must have a permeance that is less than the floor cover or surface treatment that is applied to the slab. The vapor retarder must have sufficient durability to withstand direct contact with the sub-slab base material and construction activity. The vapor retarder material should be placed according to the manufacturer's recommended method, including the taping and lapping of all joints and wall connections. The architect and/or flooring consultant should select the vapor retarder products compatible with flooring and adhesive materials.

The floor slab should be appropriately cured using moisture retention methods after casting. Typical floor slab curing methods should be used for at least 7 days. The architect or flooring consultant should assign curing methods consistent with current applicable American Concrete Institute (ACI) procedures with consideration of curing method compatibility to proposed surface treatments, flooring and adhesive materials.

4.8 Fill, Backfill and Compaction

We recommend the following fill and backfill materials: recycled products must also be tested in accordance with applicable environmental regulations and approved by a qualified environmental consultant.

Common Borrow: Fill to raise grades in landscape areas should be non-organic compactable earth meeting the requirements of 2014 MaineDOT Standard Specification 703.18 Common Borrow.

Gravel Borrow: Use as general yard fil, as well as to repair soft areas, should be sand or silty sand meeting the following gradation:

Gravel Borrow		
Sieve Size	**Percent Finer by Weight**	
6 inch	100	100
Portion Passing 3 inch Sieve		
1/4 -inch	0 to 70	0 to 70
No. 200	0 to 10	0 to 20

In our opinion, 2014 MaineDOT Standard Specification 703.20 Gravel Borrow meets the requirements of Gravel Borrow.

Structural Fill: Use as general yard fill, backfill for foundations, slab base material and material below exterior entrances slabs should be clean, non-frost susceptible sand and gravel meeting the gradation requirements for Structural Fill as given below:

Structural Fill	
Sieve Size	**Percent Finer by Weight**
4 inch	100
3 inch	90 to 100
¼ inch	25 to 90
No. 40	0 to 30
No. 200	0 to 6

Crushed Stone: Crushed Stone, used beneath foundations and for underdrain aggregate should be washed ¾-inch crushed stone meeting the requirements of 2014 MaineDOT Standard Specification 703.22 Underdrain Backfill Material Type C is suitable for use as Crushed Stone.

Reuse of Site Soils: The on-site soils are unsuitable for reuse within the proposed yard area, but likely could be used in landscape areas. Blasted and crushed bedrock can likely be reused to blend with sand and gravel borrow and processed to create Gravel Borrow. The native stiff silty clay may be suitable for reuse as Common Borrow, such as pond berms, provided it is at a compactable moisture content at the time of reuse.

Placement and Compaction: Fill should be placed in horizontal lifts and compacted such that the desired density is achieved throughout the lift thickness with 3 to 5 passes of the compaction equipment. Loose lift thicknesses for grading, fill and backfill activities should not exceed 12 inches. We recommend that fill and backfill in building and paved areas be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557. Crushed Stone should be compacted with 3 to 5 passes of a vibratory plate compactor having a static weight of at least 500 pounds.

4.9 Weather Considerations

Construction activity should be limited during wet and freezing weather and the site soils may require drying or thawing before construction activities may continue. The contractor should anticipate the need for water to temper fills in order to facilitate compaction during dry weather. If construction takes place during cold weather, subgrades, foundations and floor slabs must be protected during freezing conditions. Concrete and fill must not be placed on frozen soil; and once placed, the concrete and soil beneath the structure must be protected from freezing.

4.10 Design Review and Construction Testing

S.W.COLE should be retained to review the construction documents prior to bidding to determine that our earthwork, foundation and pavement recommendations have been properly interpreted and implemented.

A soils and concrete testing program should be implemented during construction to observe compliance with the design concepts, plans, and specifications. S.W.COLE is available to observe earthwork activities, the preparation of foundation bearing surfaces and pavement subgrades, as well as to provide testing and IBC Special Inspection services for soils, concrete, steel, spray-applied fireproofing, structural masonry and asphalt construction materials.

4.11 Recommendations for Additional Study

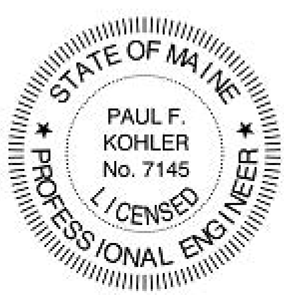
We understand design of the substation pad, buildings and equipment is still in development. Additional explorations, laboratory soils and rock testing and evaluation may be needed as design of the substation progresses. Field soil resistivity and an acidic rock evaluation should also be made. Additional soil chloride and sulfate testing is recommended considering the higher than anticipated values reported.

5.0 CLOSURE

It has been a pleasure to be of assistance to you with this phase of your project. We look forward to working with you during the construction phase of the project.

Sincerely,

S. W. Cole Engineering, Inc.



Paul F. Kohler, P.E.
Senior Geotechnical Engineer

PFK:mas

APPENDIX A

Limitations

This report has been prepared for the exclusive use of Central Maine Power Company for specific application to the proposed Substation on Fickett Road in Pownal, Maine. S. W. Cole Engineering, Inc. (S.W.COLE) has endeavored to conduct our services in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

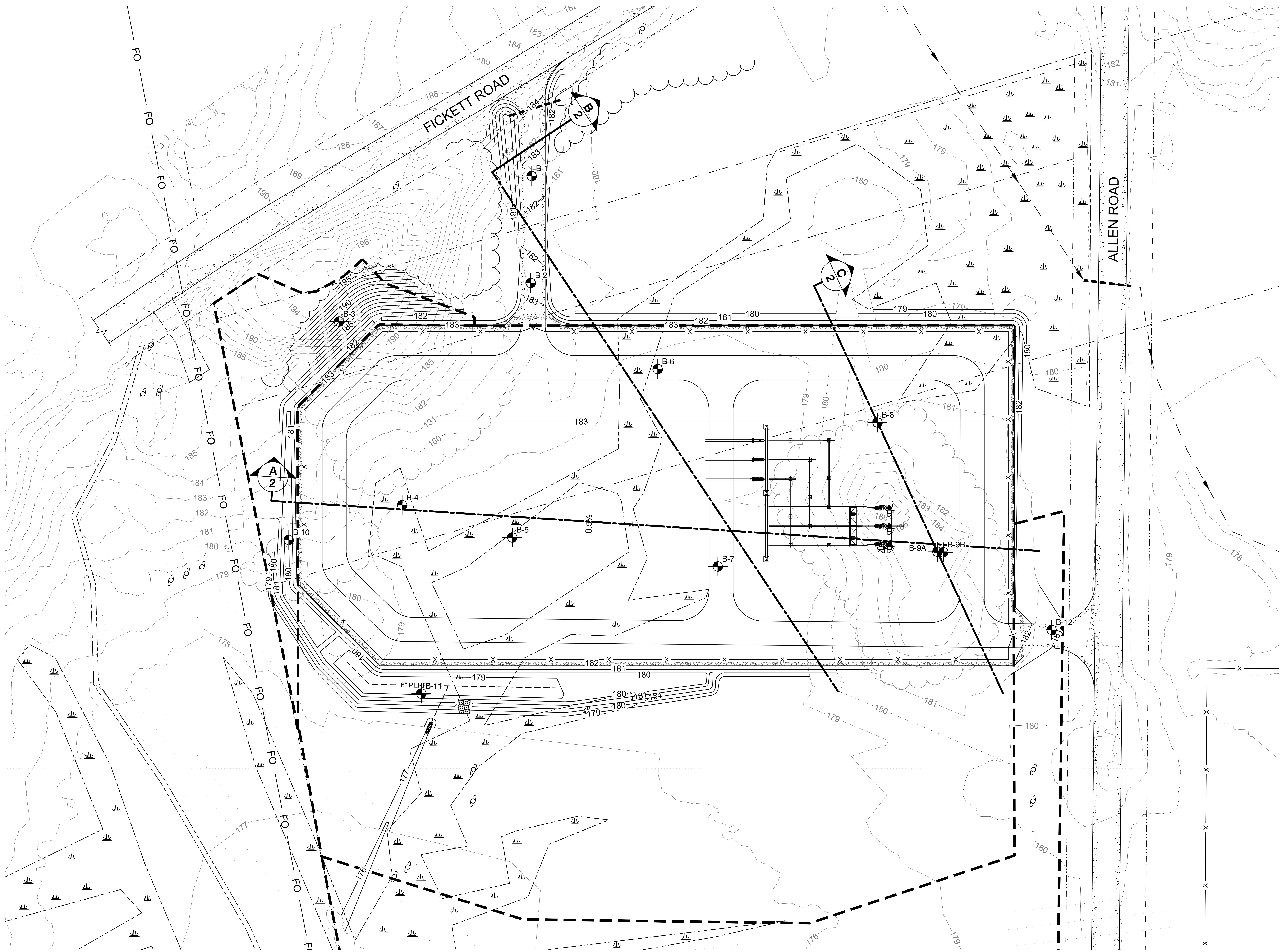
Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

S.W.COLE's scope of services has not included the investigation, detection, or prevention of any Biological Pollutants at the project site or in any existing or proposed structure at the site. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and the byproducts of any such biological organisms.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S.W.COLE should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S.W.COLE.

APPENDIX B

Figures



LEGEND:

APPROXIMATE BORING LOCATION

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A 1"=50' SCALE PLAN OF THE SITE ENTITLED "BORING LOCATION PLAN, PROPOSED CONDITIONS," PREPARED BY POWER ENGINEERS, INC., DATED 4/10/2018.
2. THE BORING LOCATIONS WERE SELECTED BY POWER ENGINEERS, INC. AND LOCATED IN THE FIELD BY GPS SURVEY BY S. W. COLE ENGINEERING, INC. USING A MAPPING GRADE TRIMBLE GPS RECEIVER.
3. THIS PLAN SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S. W. COLE ENGINEERING, INC. GEOTECHNICAL REPORT.
4. THE PURPOSE OF THIS PLAN IS ONLY TO DEPICT THE LOCATION OF THE EXPLORATIONS IN RELATION TO THE EXISTING CONDITIONS AND PROPOSED CONSTRUCTION AND IS NOT TO BE USED FOR CONSTRUCTION.

0 40 80 Feet

1	05/29/2018	INTERPRETIVE GEOLOGIC PROFILES	CEM
0	05/16/2018	PRELIMINARY FINDINGS SUBMISSION	CEM
NO.	*DATE*	*DESCRIPTION*	*BY*

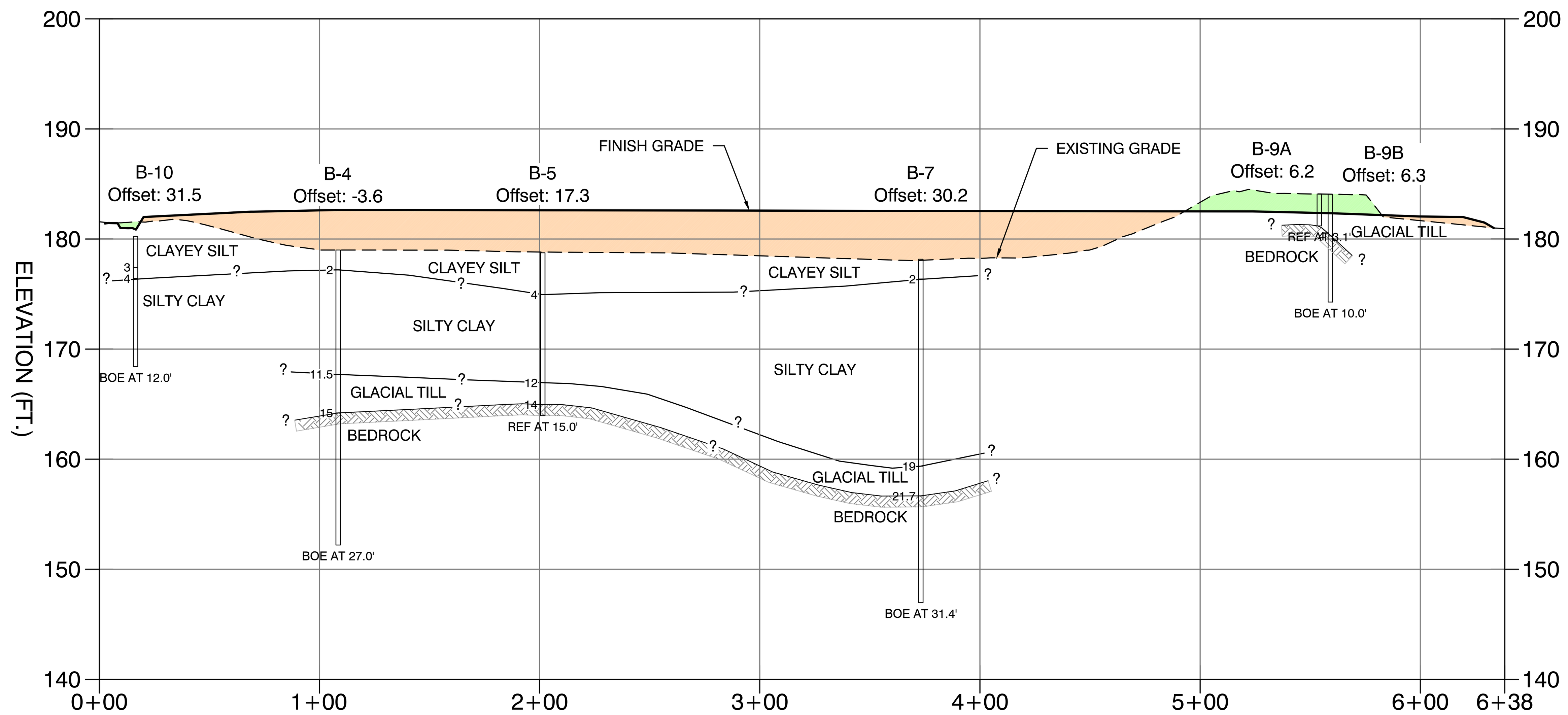
S.W.COLE ENGINEERING, INC.

CENTRAL MAINE POWER

EXPLORATION LOCATION PLAN

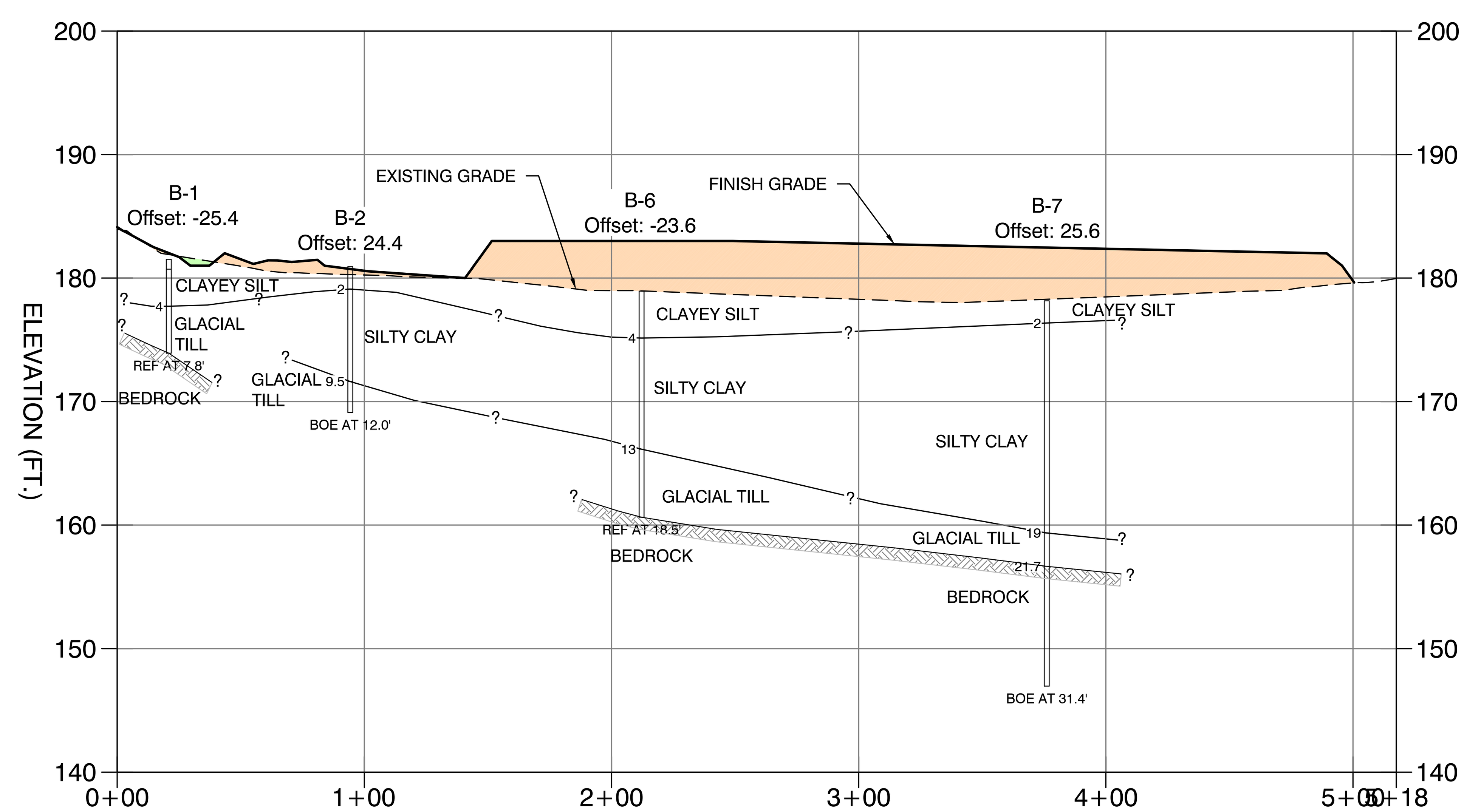
PROPOSED FICKETT ROAD SUBSTATION
FICKETT ROAD
POWNAL, MAINE

Job No.: 17-1016 Scale: As Noted
Date : 05/16/2018 Sheet: 1



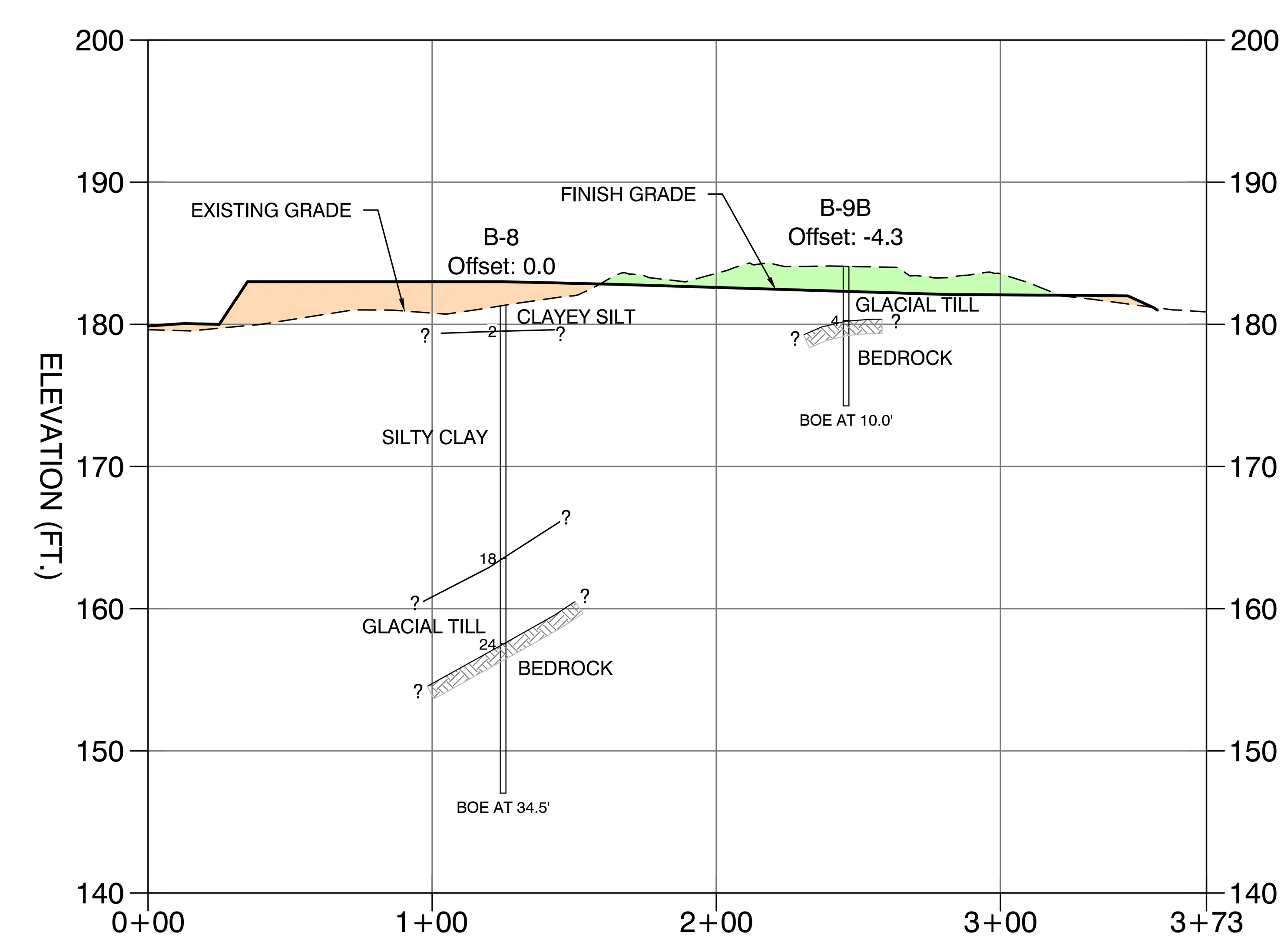
PROFILE A

SCALE: 1" = 50' HORIZ.
1" = 10' VERT.



PROFILE B

SCALE: 1" = 50' HORIZ.
1" = 10' VERT.



PROFILE C

SCALE: 1" = 50' HORIZ.
1" = 10' VERT.

LEGEND

B-9 (Offset: 5')	BORING NUMBER OFFSET FROM PROFILE
	APPROXIMATE EXISTING GROUND SURFACE
7'	STRATA CHANGE
SILT	STRATA DEFINITION
BOE REF	BOTTOM OF EXPLORATION REFUSAL - PROBABLE BEDROCK

NOTES:

1. THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTION WERE GENERALIZED FROM AND INTERPOLATED BETWEEN EXPLORATION LOCATIONS. THE TRANSITION BETWEEN MATERIALS MAY BE MORE OR LESS GRADUAL THAN INDICATED. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE SPECIFIC LOCATIONS INDICATED AND AT THE TIME OF EXPLORATION. SEE BORING LOGS FOR MORE DETAILED INFORMATION.
2. THIS PROFILE SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S. W. COLE ENGINEERING, INC. GEOTECHINCAL REPORT AND IS NOT TO BE USED FOR CONSTRUCTION.

NO.	DATE	DESCRIPTION	BY
1	05/29/2018	INTERPRETIVE GEOLOGIC PROFILES	CEM
0	05/16/2018	PRELIMINARY FINDINGS SUBMISSION	CEM

S.W.COLE ENGINEERING, INC.

CENTRAL MAINE POWER

INTERPRETIVE GEOLOGIC PROFILES A, B & C

PROPOSED FICKETT ROAD SUBSTATION
FICKETT ROAD
POWNAL, MAINE

Job No.:	17-1016	Scale:	As Noted
Date :	05/16/2018	Sheet:	2

APPENDIX C

Exploration Logs and Key

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: CMP
PROJECT: Proposed Substation
LOCATION: Fickett Road, Pownal, Maine

BORING NO.: B- 1
SHEET: 1 of 1
PROJECT NO. 17-1016
DATE START: 4/20/2018
DATE FINISH: 4/20/2018

Drilling Information

LOCATION: See Exploration Location Plan
ELEVATION (FT): 181.5' +/-
TOTAL DEPTH (FT): 7.8
LOGGED BY: Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC
DRILLER: Jeff Lee
DRILLING METHOD: Solid Stem Auger
RIG TYPE: Track Mounted CME 850
AUGER ID/OD: N/A / 4 1/2 in
SAMPLER: Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic
HAMMER WEIGHT (lbs): 140 / 140
CASING ID/OD: N/A /N/A
CORE BARREL:
HAMMER EFFICIENCY FACTOR: 0.81
HAMMER DROP (inch): 30 / 16
WATER LEVEL DEPTHS (ft): 4/20/2018 Soils wet at 5'
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D		0-2	24/20	WOH-1-2-6			0.5 Loose, grass / topsoil		
180										Very stiff to stiff, gray-brown clayey SILT, some sand with rootlets		
			2D		2-4	24/24	6-9-12-14	q_P=8 ksf				
	5									4.0 Medium dense, brown silty gravelly SAND		
175			3D		5-7	24/15	8-9-14-18					
										7.8		

Refusal at 7.8 feet
Auger refusal, probable bedrock

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 1

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: CMP
PROJECT: Proposed Substation
LOCATION: Fickett Road, Pownal, Maine

BORING NO.: B- 2
SHEET: 1 of 1
PROJECT NO. 17-1016
DATE START: 4/20/2018
DATE FINISH: 4/20/2018

Drilling Information

LOCATION: See Exploration Location Plan
ELEVATION (FT): 181' +/-
TOTAL DEPTH (FT): 12.0
LOGGED BY: Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC
DRILLER: Jeff Lee
DRILLING METHOD: Solid Stem Auger
RIG TYPE: Track Mounted CME 850
AUGER ID/OD: N/A / 4 1/2 in
SAMPLER: Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic
HAMMER WEIGHT (lbs): 140 / 140
CASING ID/OD: N/A /N/A
CORE BARREL:
HAMMER EFFICIENCY FACTOR: 0.81
HAMMER DROP (inch): 30 / 16
WATER LEVEL DEPTHS (ft): ⊻ 0.5 ft 4/20/2018 Free water at 0.5'
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
⊻ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling

D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear

Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot

WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector

S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D		0-2	24/18	1-2-3-4		0.5	Loose, grass / topsoil	⊻	
180										Loose, brown clayey SILT, some sand with organics		
			2D		2-4	24/18	5-8-12-14	q_P=9 to 8 ksf	2.0	Hard to stiff, brown silty CLAY		
	5		3D		5-7	24/24	4-4-5-7					
175								q_P=5 to 3 ksf				
	10								9.5	Medium dense, brown silty gravelly SAND		
			4D		10-12	24/16	7-9-8-50					
170									12.0	Bottom of Exploration at 12.0 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 2

S.W.COLE ENGINEERING, INC.

BORING LOG

BORING NO.:	B- 3
SHEET:	1 of 1
PROJECT NO.	17-1016
DATE START:	4/25/2018
DATE FINISH:	4/25/2018

CLIENT: CMP
PROJECT: Proposed Substation
LOCATION: Fickett Road, Pownal, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 194' +/- **TOTAL DEPTH (FT):** 3.5 **LOGGED BY:** Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** N/A /N/A **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.81 **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): 4/25/2018 No free water observed
GENERAL NOTES: Moved 3' +/- southeast of B-3. Auger refusal at 3'.

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D		0-2	24/7	1-1-2-8			Loose, forest duff / brown sandy SILT with organics		
										1.0 Loose, brown silty gravelly SAND		
										3.5 Refusal at 3.5 feet Auger refusal, probable bedrock		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 3

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: CMP
PROJECT: Proposed Substation
LOCATION: Fickett Road, Pownal, Maine

BORING NO.: B- 4
SHEET: 1 of 1
PROJECT NO. 17-1016
DATE START: 4/24/2018
DATE FINISH: 4/24/2018

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 179' +/- **TOTAL DEPTH (FT):** 27.0 **LOGGED BY:** Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2
HAMMER EFFICIENCY FACTOR: 0.81 **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): 4/24/2018 Water introduced during drilling
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D		0-2	24/20	1-1-3-4			Very loose, grass / topsoil		
									1.0	Loose, gray-brown sandy clayey SILT with roots and organics		
			2D		2-4	24/16	4-7-12-17	q_P=9 ksf	2.0	Hard, gray-brown silty CLAY, some sand		
175	5		3D		5-7	24/24	3-6-7-8	q_P=6.5 to 4 ksf	4.0	Very stiff to stiff, brown silty CLAY		
170	10		4D		10-12	24/22	1-2-5-15	q_P=3 to 1 ksf	9.0	Medium, olive brown silty CLAY		
									11.5	Dense, brown silty gravelly SAND with weathered rock		
165	15		5D		15-15.9	11/6	34-50/5"		15.0	Highly weathered rock between 15-16' Roller cone through bedrock from 15.9-17'		
160	20		1R		17-22	60/54	77			1R - Light gray GRANITE; hard, non-foliated, fresh-slightly weathered, fractures at 0-5, 30-40 and 55 degrees from horizontal.		
155	25		2R		22-27	60/60	93			2R - fresh-slightly weathered, fractures at 0-5 degrees from horizontal.		
									27.0	Bottom of Exploration at 27.0 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: CMP
PROJECT: Proposed Substation
LOCATION: Fickett Road, Pownal, Maine

BORING NO.: B- 5
SHEET: 1 of 1
PROJECT NO. 17-1016
DATE START: 4/24/2018
DATE FINISH: 4/24/2018

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 179' +/- **TOTAL DEPTH (FT):** 15.0 **LOGGED BY:** Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.81 **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): 4/24/2018 Water introduced during drilling
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D		0-2	24/18	1-2-3-4		0.5	Loose, grass / topsoil		
										Loose, gray clayey SILT with roots and organics		
			2D		2-4	24/24	4-6-9-12	q_P=7 to 4 ksf	2.0	Very stiff, gray-brown sandy clayey SILT		
175	5		3D		5-7	24/24	4-4-5-8	q_P=6.5 to 4 ksf	4.0	Very stiff to stiff, brown silty CLAY		
170	10		4D		10-12	24/24	1-1-8-7	q_P=3 to 1 ksf	8.5	Medium, olive-brown silty CLAY		
									12.0	Probable silty gravelly SAND		
165	15								14.0	Advanced by roller cone through probable bedrock		
									15.0			

Bottom of Exploration at 15.0 feet
Probable bedrock

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: CMP
PROJECT: Proposed Substation
LOCATION: Fickett Road, Pownal, Maine

BORING NO.: B- 6
SHEET: 1 of 1
PROJECT NO. 17-1016
DATE START: 4/20/2018
DATE FINISH: 4/20/2018

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 179' +/- **TOTAL DEPTH (FT):** 18.5 **LOGGED BY:** Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.81 **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): 4/23/2018 Water introduced during drilling
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling

D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear

Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot

WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector

S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
			1D	X	0-2	24/18	1-3-5-5			0.4 Loose, grass / topsoil		
										Stiff, gray-brown clayey SILT, some sand		
			2D	X	2-4	24/22	5-9-11-13	q_P=7 ksf				
175	5									4.0 Very stiff to stiff, brown silty CLAY		
			3D	X	5-7	24/24	3-4-5-7	q_P=6 ksf				
170	10									8.5 Medium, gray silty CLAY		
			4D	X	10-12	24/24	WOH FOR 12"-2-2	q_P=2 to 1 ksf w =37.5 %				
										11.0 Medium, olive brown silty CLAY, some sand		
165	15									13.0 Medium dense to dense, brown silty gravelly SAND		
			5D	X	15-17	24/12	6-12-18-20	w =11.6 %				
										18.5 Refusal at 18.5 feet Probable bedrock		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 6

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: CMP
PROJECT: Proposed Substation
LOCATION: Fickett Road, Pownal, Maine

BORING NO.: B- 7
SHEET: 1 of 1
PROJECT NO. 17-1016
DATE START: 4/20/2018
DATE FINISH: 4/20/2018

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 179' +/- **TOTAL DEPTH (FT):** 31.4 **LOGGED BY:** Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2
HAMMER EFFICIENCY FACTOR: 0.81 **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): 4/20/2018 Ponded water at ground surface. Water introduced during drilling at 10'.
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D	D	0-2	24/18	2-3-6-9			0.5 Loose, grass / topsoil		
										Loose, brown sandy clayey SILT with rootlets		
			2D	D	2-4	24/20	6-8-12-12	q_P=8 to 7 ksf		2.0 Very stiff to stiff, brown silty CLAY		
175	5		3D	D	5-7	24/22	3-3-4-5	q_P=6 ksf				
170	10									8.5 Medium, gray silty CLAY		
			4D	D	10-12	24/24	WOH FOR 18"-2	q_P=0.5 ksf w =40.3 %				
165	15		1U	U	15-17	24/24		q_U=1.2 ksf W_L=55 W_P=24 w =41.6 %				
			1V	V	17-17	0/0						
160	20									19.0 Medium, brown silty gravelly SAND		
			5D	D	20-21.8	22	2-3-8-50/4"					
			1R	R	22-27	60/55	59	Rock compressive strenth: 15.7 kSI		21.7 Roller cone through probable bedrock from 21.8-22' 1R - Light gray GRANITE; hard, non-foliated, fresh-slightly weathered, fractures at 10-30 degrees and 45 degrees from horizontal.		
155	25											
			2R	R	27-31.3	51/39	58			2R - slightly weathered, fractures at 0-10 degrees and 30 degrees from horizontal.		
150	30											
										31.4 Bottom of Exploration at 31.4 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 7

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: CMP
PROJECT: Proposed Substation
LOCATION: Fickett Road, Pownal, Maine

BORING NO.: B- 8
SHEET: 1 of 1
PROJECT NO. 17-1016
DATE START: 4/23/2018
DATE FINISH: 4/23/2018

Drilling Information

LOCATION: See Exploration Location Plan | ELEVATION (FT): 181' +/- | TOTAL DEPTH (FT): 34.5 | LOGGED BY: Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC | DRILLER: Jeff Lee | DRILLING METHOD: Cased Boring
RIG TYPE: Track Mounted CME 850 | AUGER ID/OD: N/A / N/A | SAMPLER: Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic | HAMMER WEIGHT (lbs): 140 / 140 | CASING ID/OD: 4 in / 4 1/2 in | CORE BARREL: NQ2
HAMMER EFFICIENCY FACTOR: 0.81 | HAMMER DROP (inch): 30 / 16
WATER LEVEL DEPTHS (ft): 4/23/2018 Water introduced during drilling
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
180			1D	D	0-2	24/24	1-2-3-6		0.5	Loose, grass / topsoil		
			2D	D	2-4	24/18	6-9-12-12	q_P=9 to 8 ksf	2.0	Loose, gray clayey SILT with roots and organics		
175	5		3D	D	5-7	24/18	3-4-6-7	q_P=7 ksf		Hard to stiff, brown silty CLAY		
170	10		4D	D	10-12	24/24	1-1-2-3	q_P=0.5 ksf w =35.8 %	9.0	Medium, olive-gray silty CLAY		
165	15		1U	U	15-17	24/24		q_U=2.8 ksf	13.0	Medium, gray silty CLAY with frequent sand seams below 17'		
			5D	D	17-19	24/20	1-6-8-10	q_P=0.5 ksf W_L=48 W_P=22 w =42.2 %				
160	20		6D	D	20-22	24/10	7-6-4-8	q_P=0.5 ksf w =11.7 %	18.0	Medium dense, gray silty gravelly SAND		
155	25		1R	R	24.5-29.5	60/60	60		24.0	Roller cone through probable bedrock from 24-24.5' 1R - Light gray GRANITE, abundant biotite mica from 24.5-25.7'; hard, non-foliated, fresh-slightly weathered, fractures at 15-45 degrees from horizontal.		
150	30		2R	R	29.5-34.5	60/60	92			2R - fresh-slightly weathered, fractures at 25-35 degrees from horizontal.		
									34.5	Bottom of Exploration at 34.5 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 8

BORING LOG

S.W.COLE ENGINEERING, INC.

BORING NO.: B- 9A
SHEET: 1 of 1
PROJECT NO. 17-1016
DATE START: 4/23/2018
DATE FINISH: 4/23/2018

CLIENT: CMP
PROJECT: Proposed Substation
LOCATION: Fickett Road, Pownal, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 184' +/- **TOTAL DEPTH (FT):** 3.1 **LOGGED BY:** Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** N/A /N/A **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.81 **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): 4/23/2018 No free water observed
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
			1D		0-1.7	20/6	1-2-4-50/2"			0.5 Forest duff Medium dense, brown silty gravelly SAND with cobbles (Reworked)		
										3.1 Refusal at 3.1 feet Auger refusal, probable bedrock		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 9A

S.W.COLE ENGINEERING, INC.

BORING LOG

CLIENT: CMP
PROJECT: Proposed Substation
LOCATION: Fickett Road, Pownal, Maine

BORING NO.: B- 9B
SHEET: 1 of 1
PROJECT NO. 17-1016
DATE START: 4/25/2018
DATE FINISH: 4/25/2018

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 184' +/- **TOTAL DEPTH (FT):** 10.0 **LOGGED BY:** Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2
HAMMER EFFICIENCY FACTOR: 0.81 **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): 4/25/2018 No free water observed
GENERAL NOTES: Moved 7' +/- northwest of B-9A

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
										0.5 Forest duff / brown SILT and SAND with organics		
										Brown silty gravelly SAND		
180										4.0 Roller cone through probable bedrock 4-5'		
	5		1R		5-10	60/60	55	Rock compressive strength: 13.3 kSI		Gray GRANITE (pegmatite zone from 5 to 8'); hard, fresh-slightly weathered, fractures at 0-5, 30-40 and 55 degrees from horizontal.		
175												
	10									10.0 Bottom of Exploration at 10.0 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B- 9B

BORING LOG

S.W.COLE ENGINEERING, INC.

BORING NO.: B-10
SHEET: 1 of 1
PROJECT NO. 17-1016
DATE START: 4/25/2018
DATE FINISH: 4/25/2018

CLIENT: CMP
PROJECT: Proposed Substation
LOCATION: Fickett Road, Pownal, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 179.5' +/- **TOTAL DEPTH (FT):** 12.0 **LOGGED BY:** Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** N/A /N/A **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.81 **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): 4/25/2018 Soils wet below 10'
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Strata Depth	Sample Description & Classification	H_2O Depth	Remarks
			1D	X	0-2	24/6	1-3-3-2				Loose, gray-brown sandy SILT, some clay, some gravel (Reworked)		
			2D	X	2-4	24/16	2-2-3-5	q_P=7 ksf		3.0	Very stiff to stiff, gray-brown clayey SILT, some sand		
175	5									4.0	Hard to stiff, brown silty CLAY, some sand		
			3D	X	5-7	24/18	6-7-9-15	q_P=9 to 6 ksf					
170	10									10.0	Stiff to medium, olive-gray silty CLAY, some sand		
			4D	X	10-12	24/22	4-4-5-5	q_P=4 to 1 ksf					
										12.0	Bottom of Exploration at 12.0 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-10

BORING LOG

S.W.COLE ENGINEERING, INC.

BORING NO.: B-11
SHEET: 1 of 1
PROJECT NO. 17-1016
DATE START: 4/25/2018
DATE FINISH: 4/25/2018

CLIENT: CMP
PROJECT: Proposed Substation
LOCATION: Fickett Road, Pownal, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 178.5' +/- **TOTAL DEPTH (FT):** 12.0 **LOGGED BY:** Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** N/A /N/A **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.81 **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): 4/25/2018 Soils saturated at 10'
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
			1D		0-2	24/18	1-1-2-4			0.5 Loose, grass / topsoil		
										Loose, gray-brown clayey SILT, some SAND with roots		
			2D		2-4	24/24	5-9-12-14	q_P=8 ksf		2.0 Hard to stiff, brown silty CLAY		
175	5		3D		5-7	24/24	3-4-5-6	q_P=6 to 5 ksf				
170	10		4D		10-12	24/24	1-1-2-1	q_P=0.5 ksf		9.0 Medium, gray silty CLAY		
										12.0 Bottom of Exploration at 12.0 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-11

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT:	CMP
PROJECT:	Proposed Substation
LOCATION:	Fickett Road, Pownal, Maine
BORING NO.:	B-12
SHEET:	1 of 1
PROJECT NO.	17-1016
DATE START:	4/23/2018
DATE FINISH:	4/23/2018

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 180.5' +/- **TOTAL DEPTH (FT):** 12.0 **LOGGED BY:** Patrick Otto
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Solid Stem Auger
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / 4 1/2 in **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** N/A /N/A **CORE BARREL:**
HAMMER EFFICIENCY FACTOR: 0.81 **HAMMER DROP (inch):** 30 / 16
WATER LEVEL DEPTHS (ft): 4/23/2018 No free water observed
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Sample Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
180			1D	D	0-2	24/24	1-1-3-6			0.5 Loose, grass / topsoil		
										Loose, gray-brown clayey SILT with roots and organics		
			2D	D	2-4	24/20	7-9-13-13	q_P=9 to 8 ksf		2.0 Hard to very stiff, brown silty CLAY		
175	5		3D	D	5-7	24/24	2-4-5-5	q_P=6 to 4 ksf				
										8.5 Medium to soft, gray silty CLAY		
170	10		4D	D	10-12	24/24	1-1-1-1	q_P=0.5 ksf w =35 %		12.0 Bottom of Exploration at 12.0 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-12

S.W.COLE ENGINEERING, INC. • Geotechnical Engineering • Field & Lab Testing • Scientific & Environmental Consulting

KEY TO NOTES & SYMBOLS
Test Boring and Test Pit Explorations

All stratification lines represent the approximate boundary between soil types and the transition may be gradual.

Key to Symbols Used:

w	-	water content, percent (dry weight basis)
q_u	-	unconfined compressive strength, kips/sq. ft. - laboratory test
S_v	-	field vane shear strength, kips/sq. ft.
L_v	-	lab vane shear strength, kips/sq. ft.
q_p	-	unconfined compressive strength, kips/sq. ft. – pocket penetrometer test
O	-	organic content, percent (dry weight basis)
W_L	-	liquid limit - Atterberg test
W_P	-	plastic limit - Atterberg test
WOH	-	advance by weight of hammer
WOM	-	advance by weight of man
WOR	-	advance by weight of rods
HYD	-	advance by force of hydraulic piston on drill
RQD	-	Rock Quality Designator - an index of the quality of a rock mass.
γ_T	-	total soil weight
γ_B	-	buoyant soil weight

Description of Proportions:

Trace:	0 to 5%
Some:	5 to 12%
"Y"	12 to 35%
And	35+%
With	Undifferentiated

Description of Stratified Soils

Parting:	0 to 1/16" thickness
Seam:	1/16" to 1/2" thickness
Layer:	½" to 12" thickness
Varved:	Alternating seams or layers
Occasional:	one or less per foot of thickness
Frequent:	more than one per foot of thickness

REFUSAL: **Test Boring Explorations** - Refusal depth indicates that depth at which, in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

REFUSAL: **Test Pit Explorations** - Refusal depth indicates that depth at which sufficient resistance to the advance of the backhoe bucket was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man-made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.

B-7, 1R and 2R & B-8, 1R and 2R

B-4, 1R and 2R & B-9B, 1R

APPENDIX D

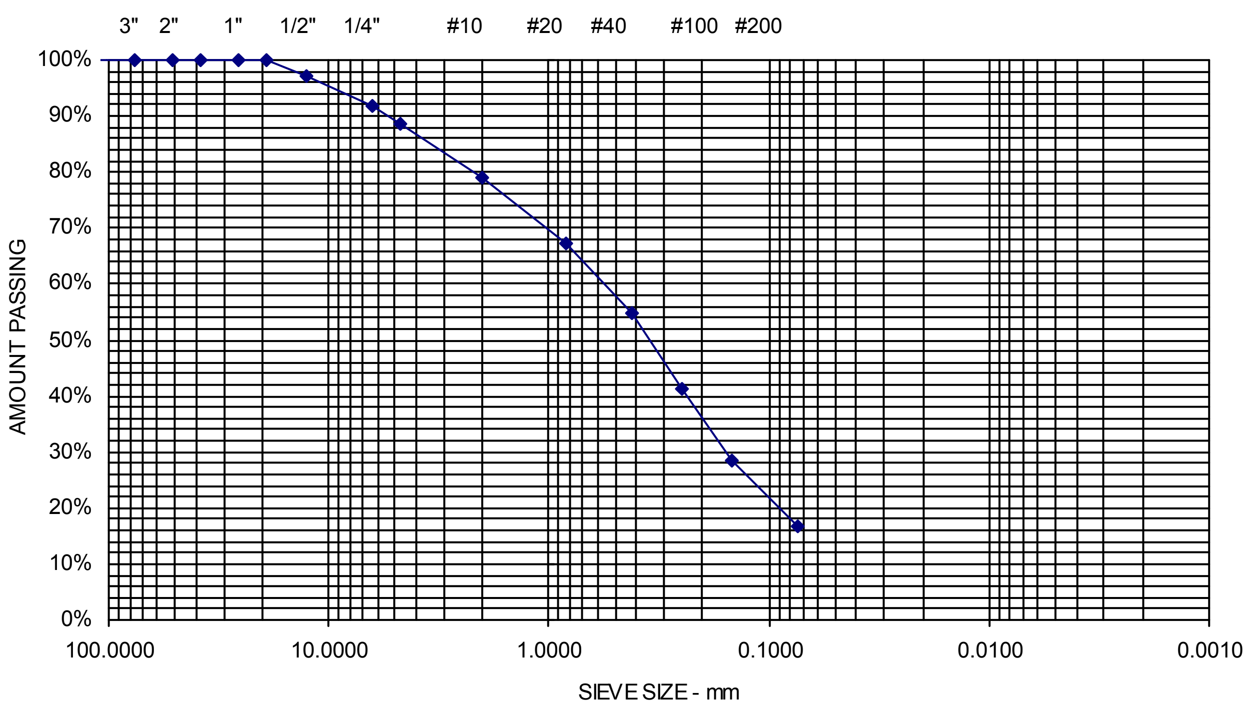
Laboratory Test Results

Report of Gradation

ASTM C-117 & C-136

Project Name	POWNAL ME - FICKETT ROAD CMP SUBSTATION EXPANSION - GEOTECHNICAL ENGINEERING SERVICES	Project Number	17-1016
Client	CENTRAL MAINE POWER COMPANY	Lab ID	23707G
		Date Received	5/4/2018
Material Source	**B-6 5D 15-17**	Date Completed	5/7/2018
		Tested By	PAUL SHAFFER

STANDARD DESIGNATION (mm/µm)	SIEVE SIZE	AMOUNT PASSING (%)	
150 mm	**6"**	**100**	
125 mm	**5"**	**100**	
100 mm	**4"**	**100**	
75 mm	**3"**	**100**	
50 mm	**2"**	**100**	
38.1 mm	**1-1/2"**	**100**	
25.0 mm	**1"**	**100**	
19.0 mm	**3/4"**	**100**	
12.5 mm	**1/2"**	**97**	
6.3 mm	**1/4"**	**92**	
4.75 mm	**No. 4**	**89**	11.4% Gravel
2.00 mm	**No. 10**	**79**	
850 um	**No. 20**	**67**	
425 um	**No. 40**	**55**	71.9% Sand
250 um	**No. 60**	**41**	
150 um	**No. 100**	**28**	
75 um	**No. 200**	**16.7**	16.7% Fines



Comments: w = 11.6%

Sheet

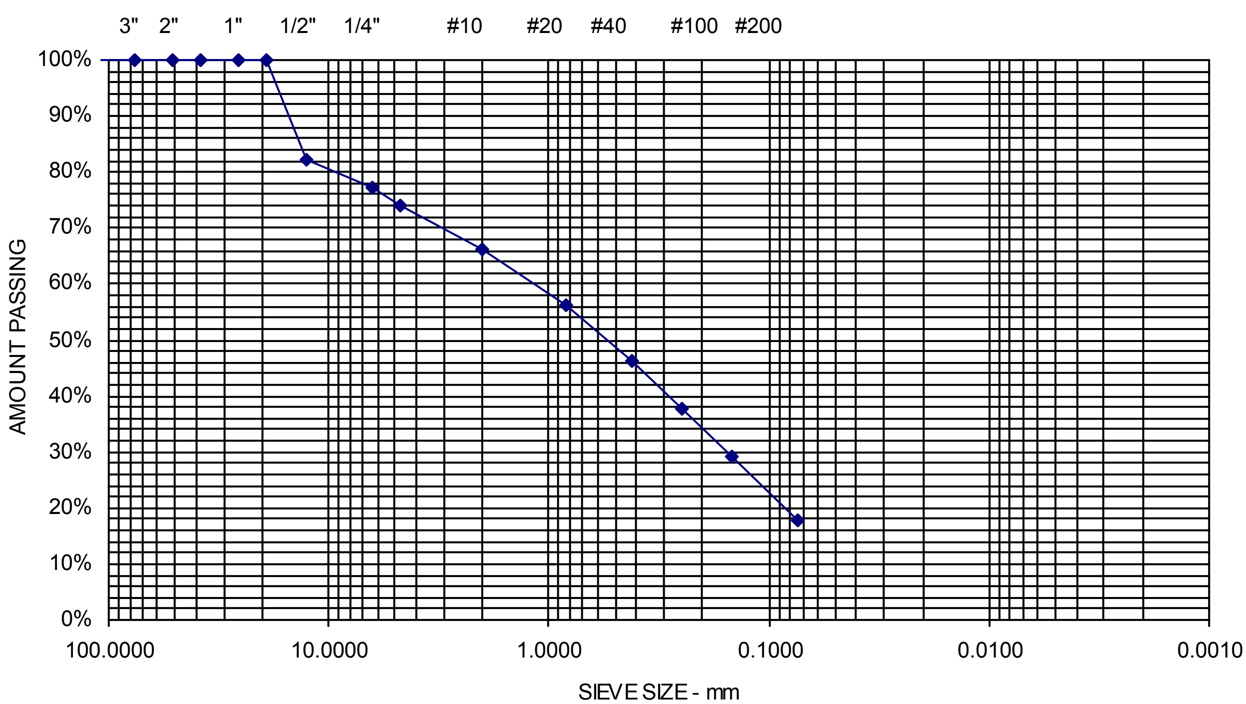
Report of Gradation

ASTM C-117 & C-136

S.W.COLE ENGINEERING, INC.

Project Name	POWNAL ME - FICKETT ROAD CMP SUBSTATION EXPANSION - GEOTECHNICAL ENGINEERING SERVICES	Project Number	17-1016
Client	CENTRAL MAINE POWER COMPANY	Lab ID	23710G
		Date Received	5/4/2018
		Date Completed	5/7/2018
Material Source	**B-8 6D 20-22**	Tested By	PAUL SHAFFER

STANDARD DESIGNATION (mm/µm)	SIEVE SIZE	AMOUNT PASSING (%)	
150 mm	**6"**	**100**	
125 mm	**5"**	**100**	
100 mm	**4"**	**100**	
75 mm	**3"**	**100**	
50 mm	**2"**	**100**	
38.1 mm	**1-1/2"**	**100**	
25.0 mm	**1"**	**100**	
19.0 mm	**3/4"**	**100**	
12.5 mm	**1/2"**	**82**	
6.3 mm	**1/4"**	**77**	
4.75 mm	**No. 4**	**74**	26% Gravel
2.00 mm	**No. 10**	**66**	
850 um	**No. 20**	**56**	
425 um	**No. 40**	**46**	56.2% Sand
250 um	**No. 60**	**38**	
150 um	**No. 100**	**29**	
75 um	**No. 200**	**17.9**	17.9% Fines



Comments: w = 11.7%

Sheet

Consolidation Test

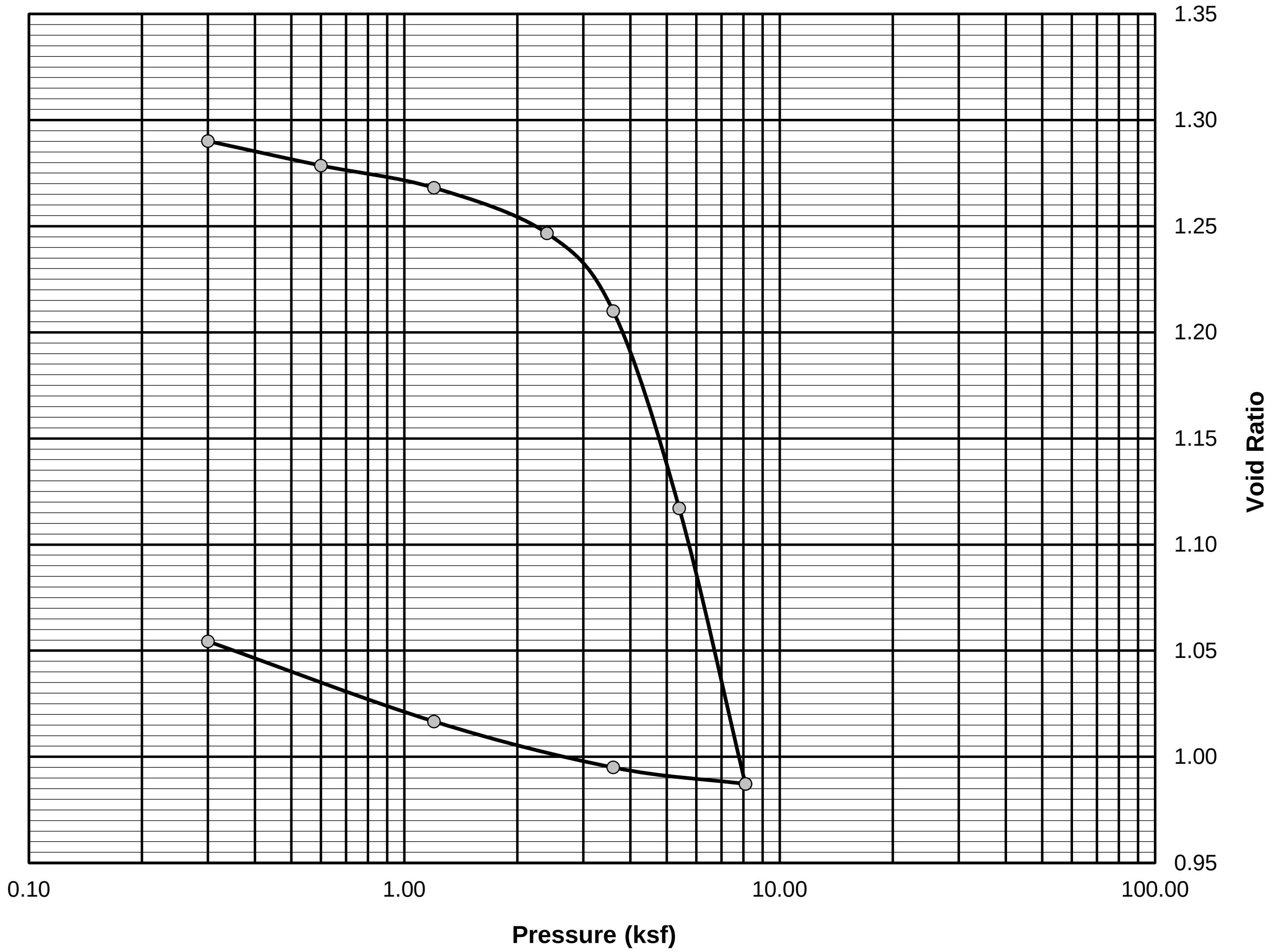
ASTM D-4767

Project Name: Fickett Road, Pownal - CMP Substation
Client: CMP

Project Number: 17-1016
Lab ID: 21478B
Date: 5/1/2018

Boring: B-7
Sample: 1U
Depth: 15-17'

P_C =	3.5 KSF
C_C =	0.74
C_R =	0.03
w =	41.6%
W_L =	55
W_P =	24



Comments:

EMW

Reviewed By

Consolidation Test

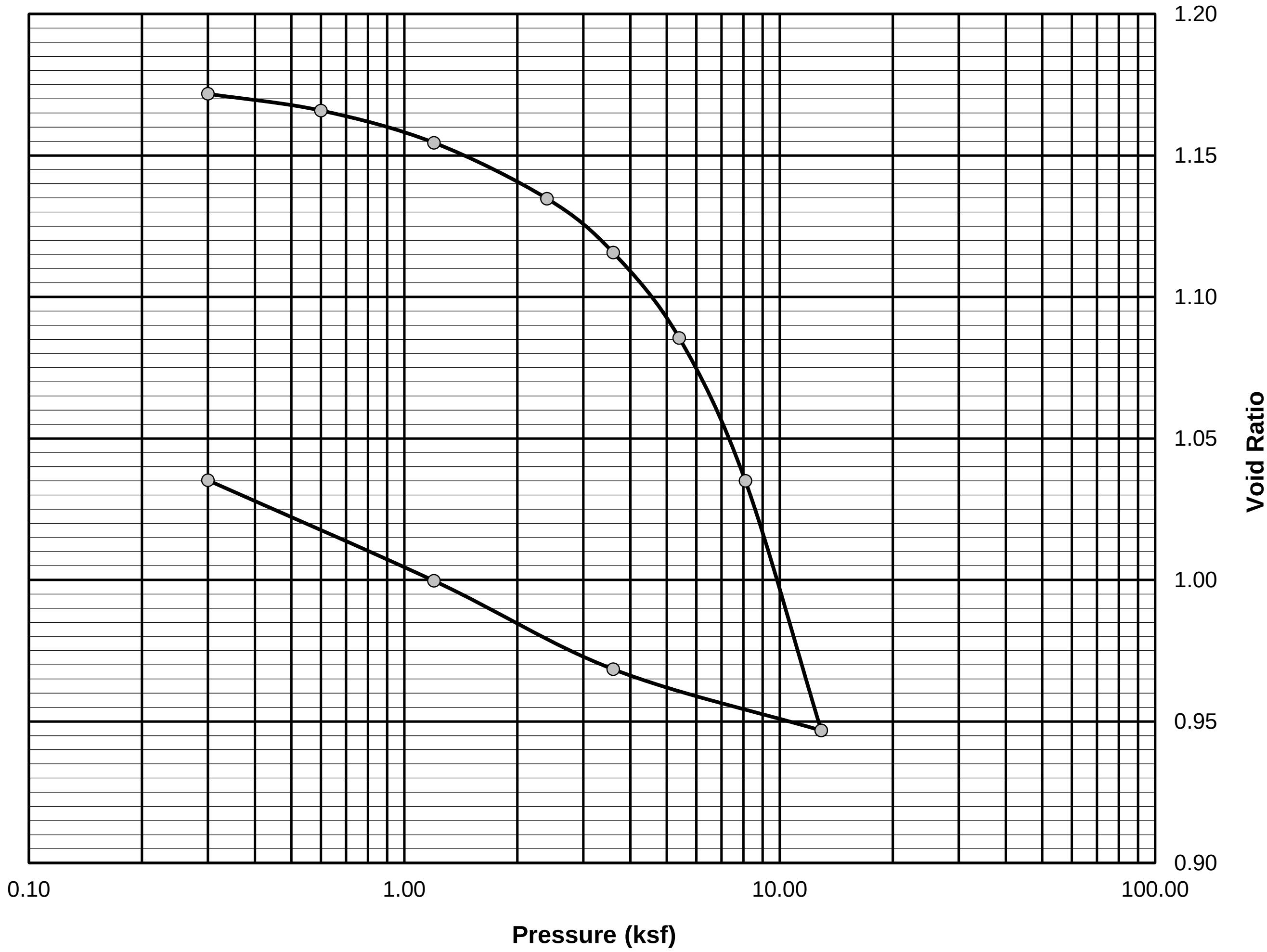
ASTM D-4767

Project Name: Fickett Road, Pownal - CMP Substation
Client: CMP

Project Number: 17-1016
Lab ID: 21479B
Date: 5/1/2018

Boring: B-8
Sample: 1U
Depth: 15-17'

P_C =	5.5 KSF
C_C =	0.43
C_R =	0.3
w =	42.2%
W_L =	48
W_P =	22



Comments:

EMW

Reviewed By

June 5, 2018

Mr. Paul Kohler
S. W. Cole Engineering, Inc.
286 Portland Road
Gray,ME 04039

RE: Katahdin Lab Number: SL4518
Project ID: Pownal / 17-1016
Project Manager: Mr. Galen Nickerson
Sample Receipt Date(s): May 23, 2018

Dear Mr. Kohler:

Please find enclosed the following information:

* Report of Analysis (Analytical and/or Field)
* Quality Control Data Summary
* Chain of Custody (COC)
* Login Report

A copy of the Chain of Custody is included in the paginated report. If requested, the original COC is attached as an addendum to this report.

Should you have any questions or comments concerning this Report of Analysis, please do not hesitate to contact the project manager listed above. The results contained in this report relate only to the submitted samples. This cover letter is an integral part of the ROA.

We certify that the test results provided in this report meet all the requirements of the NELAC standards unless otherwise noted in an attached technical narrative or in the Report of Analysis.

We appreciate your continued use of our laboratory and look forward to working with you in the future. The following signature indicates technical review and acceptance of the data.

Please go to http://www.katahdinlab.com/cert for copies of Katahdin Analytical Services Inc. current certificates and analyte lists.

Sincerely,
KATAHDIN ANALYTICAL SERVICES

Leslie Dimond

Leslie Dimond - Quality Assurance Officer

06/05/2018
Date

KATAHDIN ANALYTICAL SERVICES – INORGANIC DATA QUALIFIERS

The sampled date indicated on the attached Report(s) of Analysis (ROA) is the date for which a grab sample was collected or the date for which a composite sample was completed. Beginning and start times for composite samples can be found on the Chain-of-Custody.

U Indicates the compound was analyzed for but not detected above the specified level. This level may be the Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), the Limit of Detection (LOD) or Method Detection Limit (MDL) as required by the client.

Note: All results reported as “U” MDL have a 50% rate for false negatives compared to those results reported as “U” PQL “U” LOQ or “U” LOD, where the rate of false negatives is <1%.

E Estimated value. This flag identifies compounds whose concentrations exceed the upper level of the calibration range of the instrument for that specific analysis.

J Estimated value. The analyte was detected in the sample at a concentration less than the laboratory Practical Quantitation Level (PQL) (also called Limit of Quantitation (LOQ)), but above the Method Detection Limit (MDL).

I-7 The laboratory’s Practical Quantitation Level (PQL) or LOQ could not be achieved for this parameter due to sample composition, matrix effects, sample volume, or quantity used for analysis.

A-4 Please refer to cover letter or narrative for further information.

H_ Please note that the regulatory holding time for _______ is “analyze immediately”. Ideally, this analysis must be performed in the field at the time of sample collection. _______ for this sample was not performed at the time of sample collection. The analysis was performed as soon as possible after receipt by the laboratory.

H1 - pH H2 - DO H3 - sulfite H4 - residual chlorine

T1 The client did not provide the full volume of at least one liter for analysis of TSS. Therefore, the PQL of 2.5 mg/L could not be achieved.

T2 The client provided the required volume of at least one liter for analysis of TSS, but the laboratory could not filter the full one liter volume due to the sample matrix. Therefore, the PQL of 2.5 mg/L could not be achieved.

M1 The matrix spike and/or matrix spike duplicate recovery performed on this sample was outside of the laboratory acceptance criteria. Sample matrix is suspected. The laboratory criteria was met for the Laboratory Control Sample (LCS) analyzed concurrently with this sample.

M2 The matrix spike and/or matrix spike duplicate recovery was outside of the laboratory acceptance criteria. The native sample concentration is greater than four times the spike added concentration so the spike added could not be distinguished from the native sample concentration.

R1 The relative percent difference (RPD) between the duplicate analyses performed on this sample was outside of the laboratory acceptance criteria (when both values are greater than ten times the PQL).

MCL	Maximum Contaminant Level	NL	No limit
NFL	No Free Liquid Present	FLP	Free Liquid Present
NOD	No Odor Detected	TON	Threshold Odor Number

D-1 As required by Method 5210B, APHA Standard Methods for the Examination of Water and Wastewater (21st edition), the BOD value reported for this sample is ‘qualified’ because the check standard run concurrently with the sample analysis did not meet the criteria specified in the method (198 +/- 30.5 mg/L). These results <u>may</u> not be reportable for compliance purposes.

D-2 The measured final dissolved oxygen concentrations of all dilutions were less than the method-specified limit of 1 mg/L. The reported BOD result was calculated assuming a final oxygen concentration equal to 1 mg/L. The reported value should be considered a minimum value.

D-3 The dilution water used to prepare this sample did not meet the method and/or regulatory criteria of less than 0.2 or 0.4 mg/L dissolved oxygen (DO) uptake over the five day period of incubation. These results <u>may</u> not be reportable for compliance purposes.

Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

Client: Paul Kohler
S. W. Cole Engineering, Inc.
286 Portland Road
Gray,ME 04039

Lab Sample ID: SL4518-1
Report Date: 04-JUN-18
Client PO: 17-1016
Project: Pownal / 17-1016
SDG: SL4518

Sample Description	Matrix	Date Sampled	Date Received
B5, 1D	SL	23-MAY-18 08:30:00	23-MAY-18

Parameter	Result	Adj PQL	Adj MDL	Anal. Method	QC Batch	Analysis Date	Prep. Method	Prep. Date	Analyst	Footnotes	RPD/RSD
Chloride	2600 mg/Kgdrywt	120	60.	EPA 325.2	WG229257	25-MAY-18 17:40:23	EPA 300.0	25-MAY-18	ZF		
Sulfate-Turbidimetric	1200 mg/Kgdrywt	61.	12.	EPA 375.4	WG229563	01-JUN-18 13:01:13	EPA 300.0	25-MAY-18	AP		
Total Solids	79. %	1		SM2540G	WG229148	28-MAY-18 18:12:49	SM2540G	26-MAY-18	BF		
pH(Soil)	6.4 pH	0.10	0.10	SW846 9045D	WG229009	23-MAY-18 18:45:38	SW846 9045C	23-MAY-18	SC		

Katahdin
ANALYTICAL SERVICES

Report of Analytical Results

Client: Paul Kohler
S. W. Cole Engineering, Inc.
286 Portland Road
Gray,ME 04039

Lab Sample ID: SL4518-2
Report Date: 04-JUN-18
Client PO: 17-1016
Project: Pownal / 17-1016
SDG: SL4518

Sample Description	Matrix	Date Sampled	Date Received
B8, 1D	SL	23-MAY-18 08:30:00	23-MAY-18

Parameter	Result	Adj PQL	Adj MDL	Anal. Method	QC Batch	Analysis Date	Prep. Method	Prep. Date	Analyst	Footnotes	RPD/RSD
Chloride	1200 mg/Kgdrywt	24.	12.	EPA 325.2	WG229257	25-MAY-18 17:22:27	EPA 300.0	25-MAY-18	ZF		
Sulfate-Turbidimetric	4300 mg/Kgdrywt	180	36.	EPA 375.4	WG229563	01-JUN-18 13:29:46	EPA 300.0	25-MAY-18	AP		
Total Solids	79. %	1		SM2540G	WG229148	28-MAY-18 18:13:01	SM2540G	26-MAY-18	BF		
pH(Soil)	7.1 pH	0.10	0.10	SW846 9045D	WG229009	23-MAY-18 18:50:05	SW846 9045C	23-MAY-18	SC		

600 Technology Way
P.O. Box 540, Scarborough, ME 04070
http://katahdinlab.com
sales@katahdinlab.com

Quality Control Report

Blank Sample Summary Report

Chloride

Samp Type	QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	PQL
MBLANK	WG229257	EPA 325.2	25-MAY-18	N/A	U 1.0 mg/L	2.0 mg/L

Sulfate-Turbidimetric

Samp Type	QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	PQL
MBLANK	WG229563	EPA 375.4	01-JUN-18	25-MAY-18	U 1.0 mg/L	1.0 mg/L

Total Solids

Samp Type	QC Batch	Anal. Method	Anal. Date	Prep. Date	Result	PQL
MBLANK	WG229148	SM2540G	28-MAY-18	26-MAY-18	100 %	1 %

Quality Control Report

Laboratory Control Sample Summary Report

Chloride

Lab Sample Id	Samp Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amt.	Result	Recovery	Acceptance Range	RPD
WG229257-2	LCS	WG229257	25-MAY-18	N/A	mg/L	35	36.	102	80-120	

Sulfate-Turbidimetric

Lab Sample Id	Samp Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amt.	Result	Recovery	Acceptance Range	RPD
WG229563-2	LCS	WG229563	01-JUN-18	25-MAY-18	mg/L	15	15.	101	80-120	

Total Solids

Lab Sample Id	Samp Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amt.	Result	Recovery	Acceptance Range	RPD
WG229148-2	LCS	WG229148	28-MAY-18	26-MAY-18	%	90	90.	100	90-110	

pH(Soil)

Lab Sample Id	Samp Type	QC Batch	Analysis Date	Prep Date	Units	Spike Amt.	Result	Recovery	Acceptance Range	RPD
WG229009-1	LCS	WG229009	23-MAY-18	23-MAY-18	pH	7	7.0	100	90-110	

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ANALYTICAL SERVICES

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Cert No E87604

Quality Control Report

Duplicate Sample Summary Report

Total Solids

Duplicate Sample ID	Original Sample ID	QC Batch	Analysis Date	Result Units	Sample Result	Duplicate Result	RPD(%)	RPD Limit
WG229148-3	SL4518-1	WG229148	28-MAY-18	%	79.	79.	1	20

Katahdin Analytical Services, LLC.

Sample Receipt Condition Report

Client: SW Cole	KAS PM:	Sampled By: Client
Project:	KIMS Entry By:	Delivered By: Client
KAS Work Order#: SL 4517, 4518	KIMS Review By: AMH	Received By: KF
SDG #:	Cooler: 1 of 1	Date/Time Rec.: 5/23/18 10:10

Receipt Criteria	Y	N	EX*	NA	Comments and/or Resolution
1. Custody seals present / intact?		✓			
2. Chain of Custody present in cooler?	✓				
3. Chain of Custody signed by client?	✓				
4. Chain of Custody matches samples?	✓				
5. Temperature Blanks present? If not, take temperature of any sample w/ IR gun.	✓				Temp (°C): 2.7°C
Samples received at <6 °C w/o freezing?	✓				Note: Not required for metals (except Hg soil) analysis.
Ice packs or ice present?	✓				The lack of ice or ice packs (i.e. no attempt to begin cooling process) or insufficient ice may not meet certain regulatory requirements and may invalidate certain data.
If yes, was there sufficient ice to meet temperature requirements?	✓				
If temp. out, has the cooling process begun (i.e. ice or packs present) and sample collection times <6hrs., but samples are not yet cool?				✓	Note: No cooling process required for metals (except Hg soil) analysis.
6. Volatiles: **Aqueous:** No bubble larger than a pea?	✓				
Soil/Sediment: Received in airtight container?				✓	
Received in methanol?				✓	
Methanol covering soil?				✓	
D.I. Water - Received within 48 hour HT?				✓	
Air: Refer to KAS COC for canister/flow controller requirements.	√ if air included				
7. Trip Blank present in cooler?				✓	
8. Proper sample containers and volume?	✓				
9. Samples within hold time upon receipt?	✓				
10. Aqueous samples properly preserved? Metals, COD, NH3, TKN, O/G, phenol, TPO4, N+N, TOC, DRO, TPH – pH <2	✓				
Sulfide - >9				✓	
Cyanide – pH >12				✓	

* Log-In Notes to Exceptions: document any problems with samples or discrepancies or pH adjustments.

QA-048 – Revision 6 – 07/20/2015

Katahdin ANALYTICAL SERVICES
600 Technology Way
Scarborough, ME 04074
Tel: (207) 874-2400
Fax: (207) 775-4029

EMAIL
PMOHLER@SWCOLE.COM

CHAIN of CUSTODY

PLEASE BEAR DOWN AND PRINT LEGIBLY IN PEN

Client: S.W. COLE ENG INC	Contact: PAUL MOHLER	Phone #: (207) 657-2866	Fax #: ( )
Address: 286 PORTLAND ROAD	City: GRAY	State: ME	Zip Code: 04039
Purchase Order #:	Proj. Name / No.: POWNAL / 17-1016		Katahdin Quote #:
Bill (if different than above):	Address:		
Sampler (Print / Sign):		Copies To:	

LAB USE ONLY
WORK ORDER #: SL 4518
KATAHDIN PROJECT NUMBER ____
REMARKS: ____
SHIPPING INFO: ❒ FED EX ❒ UPS ❒ CLIENT
AIRBILL NO: ____
TEMP°C ____ ❒ TEMP BLANK ❒ INTACT ❒ NOT INTACT

ANALYSIS AND CONTAINER TYPE PRESERVATIVES

*	Sample Description	Date / Time coll'd	Matrix	No. of Cntrs.	pH (Filt. ❒Y❒N)	CHLORIDES SULFATE (Filt. ❒Y❒N)	Filt. ❒Y❒N	Filt. ❒Y❒N	Filt. ❒Y❒N	Filt. ❒Y❒N	Filt. ❒Y❒N	Filt. ❒Y❒N	Filt. ❒Y❒N	Filt. ❒Y❒N
	B5, 1D	5-23 / 08:30	SOIL	1	X	X								
	B8, 1D	" / "	"	1	X	X								
		/												
		/												
		/												
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		/												
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COMMENTS

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)
Paul F. Mohler	5/23/18 9:20	[signature]	~~[signature]~~ DWB	5/23 10:00	
[signature]	5/23 / 10:00	[signature] 5-23-18 10:00		/	

Katahdin
ANALYTICAL SERVICES

Katahdin Analytical Services

Login Chain of Custody Report (lno1)

May. 23, 2018
04:25 PM

Login Number: SL4518

Quote/Incoming:

Account: SWCOLE001 NoWeb
S. W. Cole Engineering, Inc.

Project:

Primary Report Address:
Paul Kohler
S. W. Cole Engineering, Inc.
286 Portland Road

Gray,ME 04039
pkohler@swcole.com

Primary Invoice Address:
Accounts Payable
S. W. Cole Engineering, Inc.
37 Liberty Drive

Bangor,ME 04401

Report CC Addresses:
Invoice CC Addresses:

Login Information:

ANALYSIS INSTRUCTIONS	:	
CHECK NO.	:	
CLIENT PO#	:	17-1016
CLIENT PROJECT MANAGE	:	
CONTRACT	:	
COOLER TEMPERATURE	:	2.7
DELIVERY SERVICES	:	Client
EDD FORMAT	:	KAS064QC-XLS
LOGIN INITIALS	:	JCB
PM	:	GN
PROJECT NAME	:	Pownal / 17-1016
QC LEVEL	:	II+
REPORT INSTRUCTIONS	:	Please send final report and EDD to Paul (pkohler@swcole.com)
SDG ID	:	
SDG STATUS	:	
VERBAL TAT	:	

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Verbal Date	Due Date	Mailed
SL4518-1	B5, 1D	23-MAY-18 08:30	23-MAY-18			04-JUN-18	

Matrix		Product	Hold Date (shortest)	Bottle Type	Bottle Count	Comments
Solid	S	E325.2-CHLORIDE	20-JUN-18	100g Glass		
Solid	S	E375.4-SULFATE	20-JUN-18	100g Glass		
Solid	S	SW9045C-PH SOIL	20-JUN-18	100g Glass		
Solid	S	TS-ME	30-MAY-18			

Laboratory Sample ID	Client Sample Number	Collect Date/Time	Receive Date	PR	Verbal Date	Due Date	Mailed
SL4518-2	B8, 1D	23-MAY-18 08:30	23-MAY-18			04-JUN-18	

Matrix		Product	Hold Date (shortest)	Bottle Type	Bottle Count	Comments
Solid	S	E325.2-CHLORIDE	20-JUN-18	100g Glass		
Solid	S	E375.4-SULFATE	20-JUN-18	100g Glass		
Solid	S	SW9045C-PH SOIL	20-JUN-18	100g Glass		
Solid	S	TS-ME	22-JUN-18	100g Glass		

Total Samples: 2 ***Total Analyses: 8***

Exhibit G-3: West Forks and Moxie Gore Termination Stations Class B High Intensity Soils Surveys and Geotechnical Report

Class B High Intensity Soil Survey

For

Central Maine Power Company Proposed Electrical Substation

West Forks Plantation, ME

Soil Survey completed by Robert Vile Soil Consulting Inc

October 16, 2018

Robert Vile
Licensed Site Evaluator
Certified Soil Scientist

P.O. Box 114, Cates Rd.
Dixmont, ME 04932

Telephone:
(207)234-2451

Date: October 16, 2018

To: Sackett & Brake Survey, Inc.
P.O. Box 207
Skowhegan, Me. 04976

Re: Soil Suitability for a proposed CMP Electrical Substation in West Forks Plt., Me.

Findings: On October 12 and 13, 2018 I conducted a Class B High Intensity Soil Survey on the above captioned +- 5 acre parcel. Three different soil series were identified on the parcel. Tunbridge , Lyman and Brayton. The Tunbridge and Lyman soils have bedrock as the limiting factor. The Brayton soils occupy a small forested wetland area in the proposed site. If this area will be filled or disturbed then proper permitting will be required. Because of the natural sloping topography of the site it will be a cut and fill site. The shallow to ledge areas will require blasting but will produce some excellent material to fill the lower areas. The site has potential for the proposed substation.

Sincerely,

Robert G. Vile jr.

Robert G. Vile jr.
C.S.S. # 201
L.S.E. S204

Robert Vile
Licensed Site Evaluator
Certified Soil Scientist

P.O. Box 114, Cates Rd.
Dixmont, ME 04932

Telephone:
(207)234-2451

Date: October 16, 2018

To: Sackett & Brake Survey, Inc.
P.O. Box 207
Skowhegan , Me. 04976

Re: Class B High Intensity Soil Survey of a +- 5 Acre parcel of land located in West Forks Plantation, Me..for a Central Maine Power proposed electrical substation.

Findings: On October 12 and October 13,2018 I investigated the above captioned parcel. The purpose of the investigation was to conduct a Class B High Intensity Soil Survey of the site. The boundaries of the survey were marked by Land surveyors. Soils were described by means of hand shoveled test pits and many soil auger borings do to difficult access for an excavator. The soil test pit locations as well as a two foot contour map at a scale of 1" = 50' were provided by Sackett & Brake Survey, Inc. This soil survey was conducted for the use in planning a Central Maine Power Company proposed electrical substation. This Class B High Intensity Soil Survey was mapped following these minimum standards described in Guidelines For Maine Certified Soil Scientists For Soil Identification And Mapping:

Class B (High Intensity)

1. Map units will not contain dissimilar limiting individual inclusions larger than one acre. Dissimilar limiting inclusions may total more than one acre per map unit delineation, in the aggregate, if not continuous.
2. Scale of 1"=200' or larger.
3. Ground control-test pits for which detailed data is recorded are located by means of compass by chaining, pacing, or taping from known survey points; or other methods of equal or greater accuracy.
4. Base map with 5-foot contour lines.

This parcel is bedrock controlled. Three different Soil Series were identified on the parcel. Tunbridge , Lyman and Brayton soil series.

The Tunbridge soils are classified Coarse-loamy, isotic, frigid Typic Haplorthods by Soil Taxonomy. These soils are moderately deep, well drained soils formed in supraglacial till on the forested upland portions of the parcel. Tunbridge soils have bedrock between 20" and 40" on this site. They exist on slopes ranging from 3 to 40% on this site. No restrictive layers or seasonal water table was observed in these soils. A typical pedon for this series is described at Test Pit #1. Please see attached test pit logs. Tunbridge soils are a Class C Hydrologic Soil Group. Surface run-off is medium and permeability is moderately high or high throughout the profile. There is no hazard of flooding on these soils. Inclusions within the Tunbridge mapping unit include the Lyman series and the Peru soil series. The limiting factor of the Tunbridge soils for this project will be the depth to ledge. Blasting may be required.

The Lyman soils are classified Loamy, isotic, frigid Lithic Haplorthods by Soil Taxonomy. These soils are somewhat excessively drained , shallow to bedrock and formed in loamy supraglacial till. They occur on the forested uplands on this parcel. These soils have bedrock between 6 to 19" on this parcel with several bedrock outcrops. There is no seasonal watertable or restrictive layer associated with these soils. A typical pedon for this series is described at soil test boring # 5. Please see attached test pit logs. Lyman soils are a Class C/D Hydrologic Soil Group. Surface run-off is very high to high within these map units. Permeability is moderately high to high in the Lyman soils. There is no hazard of flooding within these map units. Inclusions within the Lyman map unit include the Tunbridge series where bedrock is found 20" or deeper below the mineral surface. The limiting factor with the Lyman series for this project is ledge. Blasting may be required.

The Brayton soils are classified Loamy,mixed,active,nonacid,frigid,shallow Aeric Endoaquepts by Soil Taxonomy. These soils are deep, poorly drained glacial till found in a lowland depression on this parcel. Brayton soils are hydric soils and occur within the wetland area on this site. The Brayton soils have thick organic horizons and are very bouldery on this parcel. Seasonal water tables are at the mineral surface and ponding is possible within the wetland area. Brayton soils occur on 0-3% slopes at this site. A typical pedon for this series is described at Test Pit # 4. Please see attached test pit logs. Brayton soils are a Class C Hydrologic Soil Group. Surface run-off is slow to none on this site. Inclusions within the Brayton map unit may be the very poorly drained Peachem Soil Series. The limiting factor of the Brayton soils for this project is the high seasonal water table and they are found in the forested wetland.

The accompanying soil profile descriptions, soil survey map and this soil narrative report dated October 16, 2018 were done in accordance with the standards adopted by the Maine Association of Professional Soil Scientists and presented in the " Guidelines for Maine Certified Soil Scientists for Soil Identification and Mapping" latest revision and prepared by Robert G. Vile jr. " Certified Soil Scientist # 201.

If you have any questions regarding the investigation please feel free to contact me at the above number.

Sincerely,

Robert G. Vile jr.

Robert G. Vile jr.
C.S.S. # 201
L.S.E. S204

STATE OF MAINE
Robert Vile
C.S.S. #201
CERTIFIED
SOIL SCIENTIST

FORM F 1/01

SOIL PROFILE / CLASSIFICATION INFORMATION

DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES

Project Name: Electrical Substation
Applicant Name: Central Maine Power Co.
Project Location (municipality): West Forks PLT.

Exploration Symbol: #1 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–3			Grey	
3–24	gravely SANDY LOAM	friable	Strong Brown	NONE
24–30			yellowish Brown	
30–36			light olive Brown	
36	36" HAND Dug Refusal			

soil data by S.E.	Soil: 2 Profile	Classification: AIII Condition	Slope: ___ Percent	Limiting Factor: 36 Depth	☐ Groundwater ☐ Restrictive Layer ■ Bedrock
soil data by S.S.	Soil series/phase name: Tunbridge		☐ Hydric ■ Non-hydric	Hydrologic Soil Group: C	

Exploration Symbol: #2 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–16	gravely Fine SANDY Loam	friable	Strong Brown	NONE
16–24			yellowish Brown	
24	24" Refusal HAND Dug			

soil data by S.E.	Soil: 2 Profile	Classification: AIII Condition	Slope: ___ Percent	Limiting Factor: 24 Depth	☐ Groundwater ☐ Restrictive Layer ■ Bedrock
soil data by S.S.	Soil series/phase name: Tunbridge		☐ Hydric ■ Non-hydric	Hydrologic Soil Group: C	

Exploration Symbol: #3 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–6			DARK BrowN	
6–18	gravely Fine SANDY LOAM	Friable	Strong BrowN	NONE
18–24			Yellowish BrowN	
24	24" HAND Dug Refusal			

soil data by S.E.	Soil: 2 Profile	Classification: AIII Condition	Slope: ___ Percent	Limiting Factor: 24 Depth	☐ Groundwater ☐ Restrictive Layer ■ Bedrock
soil data by S.S.	Soil series/phase name: Tunbridge		☐ Hydric ■ Non-hydric	Hydrologic Soil Group: C	

Exploration Symbol: #4 ■ Test Pit ☐ Boring

6 " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–12	Bouldery Fine SANDY Loam	Friable	DARK Greyish BrowN	Common Distinct
12–18			olive grey	
18	18" Free water in Pit			

soil data by S.E.	Soil: 3 Profile	Classification: E Condition	Slope: ___ Percent	Limiting Factor: 0 Depth	■ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: Brayton		■ Hydric ☐ Non-hydric	Hydrologic Soil Group	

INVESTIGATOR INFORMATION AND SIGNATURE

Signature: Robert G Vile Jr Date: 10-15-18

Name Printed/typed: Robert G. Vile Jr. Cert/Lic/Reg. # 55 201

Title: ■ Licensed Site Evaluator ☐ Certified Geologist ■ Certified Soil Scientist ☐ Other:

STATE OF MAINE Robert Vile C.S.S. #201 CERTIFIED SOIL SCIENTIST

affix professional seal

Rev. 1/01

FORM F 1/01

SOIL PROFILE / CLASSIFICATION INFORMATION

DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES

Project Name:	Applicant Name:	Project Location (municipality):
Electrical Substation	Central Maine Power Co.	West Forks Plt.

Exploration Symbol: #5 ☐ Test Pit ☒ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–8	Fine SANDY LOAM	Friable	DARK Yellowish BROWN	None
8	8" Ledge			

soil data by S.E.	Soil Profile: 2	Classification Condition: AL	Slope Percent:	Limiting Factor Depth: 8	☐ Groundwater ☐ Restrictive Layer ■ Bedrock

soil data by S.S. — Soil series/phase name: Lyman — ☐ Hydric ■ Non-hydric — Hydrologic Soil Group: C/D

Exploration Symbol: #6 ☐ Test Pit ☒ Boring

2 " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–18	gravelly		Strong Brown	
18–30	Fine SANDY/ LOAM	Friable	Yellowish Brown	None
30–36			Lighter olive Brown	
36	36" Refusal			

soil data by S.E.	Soil Profile: 2	Classification Condition: AIII	Slope Percent:	Limiting Factor Depth: 36	☐ Groundwater ☐ Restrictive Layer ■ Bedrock

soil data by S.S. — Soil series/phase name: Tunbridge — ☐ Hydric ■ Non-hydric — Hydrologic Soil Group: C

Exploration Symbol: ____ ☐ Test Pit ☐ Boring

____ " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–48				

soil data by S.E.	Soil Profile:	Classification Condition:	Slope Percent:	Limiting Factor Depth:	☐ Groundwater ☐ Restrictive Layer ☐ Bedrock

soil data by S.S. — Soil series/phase name: — ☐ Hydric ☐ Non-hydric — Hydrologic Soil Group:

Exploration Symbol: ____ ☐ Test Pit ☐ Boring

____ " Organic horizon thickness Ground surface elev. ____

Depth below mineral soil surface (inches)

Depth	Texture	Consistency	Color	Mottling
0–48				

soil data by S.E.	Soil Profile:	Classification Condition:	Slope Percent:	Limiting Factor Depth:	☐ Groundwater ☐ Restrictive Layer ☐ Bedrock

soil data by S.S. — Soil series/phase name: — ☐ Hydric ☐ Non-hydric — Hydrologic Soil Group:

INVESTIGATOR INFORMATION AND SIGNATURE

Signature: Robert G. Vile jr.

Date: 10-15-18

Name Printed/typed: Robert G. Vile jr.

Cert/Lic/Reg. # SS 201

Title: ■ Licensed Site Evaluator ☐ Certified Geologist ■ Certified Soil Scientist ☐ Other:

STATE OF MAINE Robert Vile C.S.S. #201 CERTIFIED SOIL SCIENTIST

affix professional seal

LOCATION TUNBRIDGE VT+MA ME NH NY

Established Series
Rev. RLM-SHG-RFL
01/2016

TUNBRIDGE SERIES

The Tunbridge series consists of moderately deep, well drained soils on glaciated uplands. They formed in loamy supraglacial till. Saturated hydraulic conductivity is moderately high or high throughout the mineral soil. Slope ranges from 0 to 80 percent. Mean annual precipitation is about 1180 mm, and mean annual temperature is about 6 degrees C.

TAXONOMIC CLASS: Coarse-loamy, isotic, frigid Typic Haplorthods

TYPICAL PEDON: Tunbridge fine sandy loam, on a west-facing, 58 percent slope under mixed northern hardwoods. (Colors are for moist soil.)

Oe--0 to 8 cm; black (7.5YR 2.5/1) moderately decomposed plant material; many very fine and fine roots; clear wavy boundary.

Oa--8 to 13 cm; black (10YR 2/1) highly decomposed plant material; many very fine and fine and common medium roots; abrupt wavy boundary. (Combined thickness of the O horizons is 0 to 15 cm.)

E--13 to 20 cm; dark gray (10YR 4/1) fine sandy loam; weak fine subangular blocky structure; friable; common fine and medium roots; 5 percent gravel and 5 percent cobbles; very strongly acid (pH 4.8); abrupt wavy boundary. (0 to 20 cm thick)

Bhs--20 to 28 cm; dark reddish brown (5YR 2.5/2) fine sandy loam; weak fine subangular blocky structure; friable; common fine and medium roots; 10 percent gravel and 2 percent cobbles; very strongly acid (pH 4.8); gradual wavy boundary.

Bs--28 to 66 cm; dark reddish brown (5YR 3/3) and reddish brown (5YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; common fine, many medium, and common coarse roots; 10 percent gravel and 3 percent cobbles; strongly acid (pH 5.2); abrupt smooth boundary. (Combined thickness of the Bhs and Bs horizons is 10 to 60 cm.)

BC--66 to 71 cm; dark yellowish brown (10YR 3/4) fine sandy loam; weak fine subangular blocky structure; friable; few medium roots; 5 percent gravel; strongly acid (pH 5.4); abrupt wavy boundary. (0 to 40 cm thick)

R--71 cm; granite bedrock.

from strongly acid to slightly acid in the substratum. Rock fragments range from 5 to 35 percent throughout the mineral soil. They are mostly gravel, channers, and cobbles, but the range includes stones. The weighted average of clay in the particle-size control section is 1 to 10 percent. The silt content in the solum and substratum is typically less than 50 percent. Stony and bouldery phases of the Tunbridge series are recognized.

The O horizons, where present, consist of slightly, intermediately, and/or highly decomposed plant material.

Some pedons have an A or Ap horizon that is neutral or has hue of 5YR to 10YR, value of 2 to 5, and chroma of 0 to 4. It is typically loam, very fine sandy loam, fine sandy loam, or sandy loam in the fine-earth fraction, but the range includes silt loam. It is up to 15 cm thick.

The E horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 1 or 2. It is typically loam, very fine sandy loam, fine sandy loam, sandy loam, loamy fine sand, or loamy sand in the fine-earth fraction, but the range includes silt loam.

Some pedons have a BE horizon that has hue of 5YR to 10YR, value of 4 to 6, and chroma of 2 to 4. Textures are similar to the E horizon.

The Bhs horizon has hue of 5YR to 10YR, with value and chroma of 3 or less.

The Bs horizon has hue of 5YR to 2.5Y, value of 3 or more and chroma of 4 or more.

The BC horizon has hue of 7.5YR to 2.5Y, value of 3 to 5, and chroma of 3 to 8.

The B horizons are typically loam, very fine sandy loam, fine sandy loam, or sandy loam in the fine-earth fraction, but the range includes silt loam. Some BC horizons have a texture of loamy sand.

Some pedons have a C horizon that has hue of 10YR to 5Y, value of 3 to 6, and chroma of 2 to 6. It is typically loam, very fine sandy loam, fine sandy loam, or sandy loam in the fine-earth fraction, but the range includes silt loam and loamy sand. It is up to 45 cm thick.

Bedrock is slightly weathered schist, gneiss, phyllite, granite, or meta-anorthosite.

COMPETING SERIES: These are the Bangor, Berkshire, Dekapen, Elliottsville, Groveton, Houghtonville, Penquis, Potsdam, Revel, and Welcome series. Bangor, Berkshire, Dekapen, Groveton, Houghtonville, Potsdam, and Welcome soils have a depth to bedrock greater than 100 cm below the mineral soil surface. Elliottsville soils have a weighted average of more than 10 percent clay in the particle-size control section. Revel soils have a paralithic contact between 50 and 100 cm and average 35 to 65 percent weathered gravel in the particle-size control section. Penquis soils contain pararock fragments of calcareous metasiltstone and metasandstone, or metalimestone throughout the soil.

GEOGRAPHIC SETTING: Tunbridge soils are on nearly level to very steep glaciated uplands. They are on the tops and sides of hills and mountains. Slope ranges from 0 to 80 percent. The soils formed in loamy supraglacial till of Wisconsin age derived mainly from micaceous schist, gneiss, phyllite, granite, and meta-anorthosite. The mean annual precipitation is 790 to 2420 mm, and the mean annual temperature is -3 to 7 degrees C. The frost-free period is from 60 to 160 days. Elevation ranges from about 2 to 800 meters above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [illegible], [illegible], [illegible], [illegible], Rawsonville, Marlow, Peru, and Sunapee soils. The very deep to bedrock Becket, Berkshire, Colonel, Marlow, Peru, and Sunapee soils are typically on footslopes and backslopes in lower positions than nearby Tunbridge soils. Additionally, Becket, Colonel, Marlow, and Peru soils formed in loamy lodgment till. Rawsonville soils are in positions similar to Tunbridge soils and have 6 percent or more organic carbon in a layer 10 cm or more thick within the spodic horizon. Tunbridge soils are often closely intermingled with shallow Lyman soils in places where local relief is controlled by the underlying bedrock.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Well drained. Saturated hydraulic conductivity is moderately high or high throughout the mineral soil.

USE AND VEGETATION: Most areas are wooded. The common trees are American beech, white ash, yellow birch, paper birch, northern red oak, sugar maple, eastern white pine, eastern hemlock, red spruce, white spruce, and balsam fir. Some areas have been cleared and are primarily used for hay and pasture. A few cleared areas are used for cultivated crops.

DISTRIBUTION AND EXTENT: Vermont, Maine, Massachusetts, New Hampshire, and New York. MLRAs 143, 144A, and 144B. The series is extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Orange County, Vermont, 1975.

REMARKS: 1. Tunbridge is the official State Soil of Vermont.

2. Albic horizons may be difficult to locate because tree throws and other disturbances have destroyed them in many areas of Tunbridge soils. Albic horizons are often thin, may be discontinuous, and located within 10 cm of the soil surface.

3. The use of the Tunbridge series in MLRA 144A is in question. Tunbridge has a frigid temperature regime which is not typical in 144A.

4. The diagnostic horizons and features recognized in this pedon are:
a. Ochric epipedon - the zone from 0 to 20 cm (Oe, Oa, E horizons).
b. Albic horizon - the zone from 13 to 20 cm (E horizon).

c. Spodic horizon - the zone from 20 to 66 cm (Bhs, Bs horizons).

ADDITIONAL DATA: Laboratory characterization data for Tunbridge and similar soils is available through the National Cooperative Soil Survey Soil Characterization Database: http://ncsslabdatamart.sc.egov.usda.gov/

National Cooperative Soil Survey
U.S.A.

LOCATION LYMAN MA+ME NH NY VT

Established Series
Rev. WHT-CAW-RFL-GWS
02/2016

LYMAN SERIES

The Lyman series consists of shallow, somewhat excessively drained soils on glaciated uplands. They formed in loamy supraglacial till. Estimated saturated hydraulic conductivity is moderately high or high throughout the mineral soil. Slope ranges from 0 to 80 percent. Mean annual precipitation is about 1175 mm, and mean annual temperature is about 5 degrees C.

TAXONOMIC CLASS: Loamy, isotic, frigid Lithic Haplorthods

TYPICAL PEDON: Lyman loam, on a northwest facing, 55 percent slope in a very rocky forested area. (Colors are for moist soil.)

Oe --0 to 3 cm; moderately decomposed plant material. (O horizon thickness is 0 to 15 cm.)

A--3 to 8 cm; black (N 2/0) loam; weak fine granular structure; very friable; many fine and medium roots; extremely acid; abrupt wavy boundary. (0 to 10 cm thick)

E--8 to 13 cm; reddish gray (5YR 5/2) fine sandy loam; weak fine granular structure; very friable; many fine and medium roots; 10 percent gravel; extremely acid; abrupt broken boundary. (0 to 25 cm thick)

Bhs--13 to 18 cm; very dusky red (2.5YR 2.5/2) loam; weak fine granular structure; friable; many fine and medium roots; 10 percent fine gravel; extremely acid; abrupt broken boundary.

Bs1--18 to 28 cm; dark red (2.5YR 3/6) loam; weak fine and medium granular structure; friable; many fine and medium roots; 10 percent fine gravel; few mica flakes; very strongly acid; clear wavy boundary.

Bs2--28 to 46 cm; brown (7.5YR 4/4) grading with depth to brown (10YR 5/3) channery loam; weak coarse subangular blocky structure parting to medium and fine granular; friable; many fine and medium roots; 15 percent channers of schist and quartzite; common flakes of mica; very strongly acid; abrupt smooth boundary. (Combined thickness of the Bhs and Bs horizons is 10 to 43 cm.)

R--46 cm; dark gray mica schist bedrock.

TYPE LOCATION: Franklin County, Massachusetts; Town of Monroe; located about 550 meters west southwest of the village of Monroe Bridge and about 55 meters south of the Deerfield River; USGS Rowe, MA topographic quadrangle; lat. 42 degrees 43 minutes 12.53 seconds N. and long. 72 degrees 56 minutes 52.71

seconds W., NAD 83.

RANGE IN CHARACTERISTICS: The thickness of the mineral solum ranges from 25 to 50 cm, and corresponds to the depth to bedrock. The weighted average of clay in the particle-size control section is 1 to 10 percent. Reaction ranges from moderately acid to extremely acid throughout, unless limed. Rock fragments range from 0 to 35 percent throughout the mineral soil. They are mostly gravel and channers, but the range includes cobbles and stones.

Some pedons have Oi, Oe, and/or Oa horizons that consist of slightly, moderately, or highly decomposed organic material, respectively.

The A horizon is neutral or has hue of 5YR to10YR, value of 2, 2.5, or 3, and chroma of 0 t0 2. Some pedons have an Ap horizon with value and chroma of 2 to 4. Ap horizons are typically 15 cm or more thick. The A or Ap horizon is sandy loam, fine sandy loam, very fine sandy loam, loam, or silt loam in the fine-earth fraction.

The E horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 1 or 2. It is loamy sand, loamy fine sand, sandy loam, fine sandy loam, very fine sandy loam, loam, or silt loam in the fine-earth fraction.

The Bhs horizon has hue of 2.5YR to 10YR, with value and chroma of 3 or less.

The Bs horizon has hue of 2.5YR to 10YR, value of 3 to 5, and chroma of 3 to 8.

Some pedons have a BC horizon with hue of 10YR to 5Y, value of 3 to 5, and chroma of 3 or 4. Texture of the B and BC horizons is sandy loam, fine sandy loam, very fine sandy loam, loam or silt loam in the fine-earth fraction. Some pedons have a loamy sand BC horizon.

Bedrock is slightly weathered schist, gneiss, phyllite, or granite.

COMPETING SERIES: These are the , , and series. Abram soils have bedrock at a depth of less than 25 cm from the mineral soil surface. Creasey soils have sandstone or conglomerate bedrock. Monson soils average more than 10 percent clay in the particle-size control section.

GEOGRAPHIC SETTING: Lyman soils are on nearly level to very steep glaciated uplands. They are on the tops and sides of hills and mountains. Slope ranges from 0 to 80 percent. The soils formed in loamy supraglacial till of Wisconsin age derived mainly from micaceous schist, gneiss, phyllite, and granite. The mean annual precipitation is 790 to 2420 mm, and the mean annual temperature is -3 to 9 degrees C. The frost-free period is from 60 to 160 days. Elevation ranges from about 2 to 800 meters above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the [illegible], [illegible], [illegible], Hogback, Marlow, Peru, Skerry, Sunapee, and Tunbridge soils. The very deep to bedrock Becket, Berkshire, Colonel, Marlow, Peru, Skerry, and Sunapee soils are typically on footslopes and backslopes in lower positions than nearby Lyman soils. In addition, Becket, Colonel, Marlow, Peru, and Skerry soils are formed in loamy lodgment till. Hogback soils are in positions similar to Lyman soils and have 6 percent or more organic carbon in a layer 10 cm or more thick within the spodic horizon. Lyman soils are often closely intermingled with the moderately deep Tunbridge soils in places where local relief is controlled by the underlying bedrock.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Somewhat excessively drained. Potential runoff is very high. Estimated saturated hydraulic conductivity is moderately high or high in the mineral soil.

USE AND VEGETATION: Most areas are wooded. The common trees are American beech, white ash, yellow birch, paper birch, northern red oak, sugar maple, eastern white pine, eastern hemlock, red spruce, white spruce, and balsam fir. Some areas have been cleared and are primarily used for hay and pasture. A few cleared areas are used for cultivated crops.

DISTRIBUTION AND EXTENT: Northern New England, western Massachusetts, and northern New York. Principally in the Green and White Mountains, the Adirondack Mountains, the Berkshire uplands, and eastern and western Maine. MLRAs 143, 144A, and 144B. The series is extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Grafton County, New Hampshire, 1935.

REMARKS: 1. The use of the Lyman series in MLRA 144A is in question. Lyman has a frigid temperature regime which is not typical in 144A.

2. Diagnostic horizons and features recognized in this pedon are:
a. Ochric epipedon - the zone from 0 to 13 cm (Oe, A, and E horizons).
b. Albic horizon - the zone from 8 to 13 cm (E horizon).
c. Spodic horizon - the zone from 13 to 46 cm (Bhs, Bs1, and Bs2 horizons).
d. Lithic feature - bedrock at 43 cm from the mineral soil surface.

ADDITIONAL DATA: Characterization data for Lyman and similar soils is available through the National Cooperative Soil Survey Soil Characterization Database: http://ncsslabdatamart.sc.egov.usda.gov/

National Cooperative Soil Survey
U.S.A.

LOCATION BRAYTON ME+CT MA NY VT

Established Series
Rev. KJL-DEW-ANA
09/2013

BRAYTON SERIES

The Brayton series consists of very deep, poorly drained soils on toeslopes and depressions of glaciated uplands. These soils formed in dense till. Saturated hydraulic conductivity is moderately high or high in the solum and moderately low or moderately high in the dense substratum. Slope ranges from 0 to 25 percent. Mean annual temperature is about 7 degrees C, and mean annual precipitation is about 1092 mm.

TAXONOMIC CLASS: Loamy, mixed, active, nonacid, frigid, shallow Aeric Endoaquepts

TYPICAL PEDON: Brayton fine sandy loam, in a gently sloping, very stony forested area. (Colors are for moist soil unless otherwise stated.)

Oi--0 to 2 cm; slightly decomposed leaves, needles and twigs.

Oa--2 to 13 cm; black (5YR 2/1) highly decomposed organic material; weak very fine granular structure; very friable, many very fine, fine and medium, and common coarse roots; extremely acid; abrupt wavy boundary. (Combined thickness of the O horizons is 0 to 15 cm.)

A--13 to 18 cm; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 6/1) dry; weak fine and medium granular structure; very friable; many very fine, fine and medium, and common coarse roots; 10 percent rock fragments; extremely acid; abrupt wavy boundary. (0 to 15 cm thick)

Eg--18 to 25 cm; gray (10YR 5/1) gravelly fine sandy loam; few medium distinct pinkish gray (5YR 6/2) masses of iron accumulation and few fine faint gray (10YR 6/1) iron depletions; weak very fine subangular blocky structure; friable; many very fine and fine, and common medium roots; 20 percent rock fragments; extremely acid; abrupt wavy boundary. (0 to 10 cm thick)

Bg--25 to 41 cm; grayish brown (2.5Y 5/2) fine sandy loam; weak very fine and fine subangular blocky structure; friable; common very fine and fine roots; many medium prominent dark yellowish brown (10YR 4/6) masses of iron accumulation and few fine faint gray (10YR 6/1) iron depletions; 10 percent rock fragments; strongly acid; clear wavy boundary. (13 to 51 cm thick)

BC--41 to 58 cm; light olive brown (2.5Y 5/4) fine sandy loam; weak thin platy structure; firm; many medium faint dark yellowish brown (10YR 4/4) masses of iron accumulation and few fine prominent gray (10YR 6/1) iron depletions; 10 percent rock fragments; moderately acid; clear wavy boundary. (0 to 25 cm thick)

Cd1--58 to 74 cm; olive (5Y 5/3) fine sandy loam; moderate thin and medium platy; very firm; many medium prominent yellowish brown (10YR 5/6) and common medium prominent dark yellowish brown masses of iron accumulation, few fine prominent gray (10YR 6/1) iron depletions; 10 percent rock fragments; slightly acid; clear wavy boundary.

Cd2--74 to 165 cm; olive (5Y 4/3) fine sandy loam; massive; very firm; common medium distinct dark yellowish brown (10YR 4/4) masses of iron accumulation, few fine prominent gray (10YR 6/1) iron depletions; 10 percent rock fragments; slightly acid.

TYPE LOCATION: Hancock County, Maine; town of Mariaville; off Maine Route 181, about 1.3 miles north of the bridge spanning the West Branch of Union River, about 500 feet southeast of highway; USGS Amherst topographic quadrangle; lat. 44 degrees 46 minutes 47 seconds N. and long. 68 degrees 22 minutes 15 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: The combined thickness of the A, E, B and BC horizons is 25 to 50 cm. Depth to bedrock from the mineral soil surface is more than 152 cm. Reaction ranges from extremely acid to moderately acid in the A and Eg horizons and from strongly acid to slightly acid in the B and BC horizons. One or more subhorizons in the subsoil below a depth of 25 cm have pH greater than 5.5. The Cd layer ranges from moderately acid to neutral. Rock fragments in the mineral soil range from 5 to 35 percent by volume. The proportions of rock fragments are about 80 percent gravel, 15 percent cobbles, and 5 percent stones. Some pedons have channers and flagstones. Stones and boulders cover from 0 to 25 percent of the surface. Textures of the solum are silt loam, loam, very fine sandy loam, fine sandy loam, or sandy loam in the fine-earth fraction with less than 10 percent clay. The substratum textures are loam, very fine sandy loam, fine sandy loam, or sandy loam in the fine-earth fraction with less than 10 percent clay. Consistence is very friable to firm in the solum and firm or very firm in the dense substratum.

The O horizon, where present, is fibric, hemic and/or sapric material.

The A or Ap horizon, where present, has hue of 10YR to 5Y, value of 2 to 4, and chroma of 1 to 4. Structure is granular.

The Eg horizon, where present, has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 or 2.

The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It has subangular blocky, granular or platy structure.

The BC horizon, where present, has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 to 4. It has subangular blocky or platy structure.

One or more subhorizon in the subsoil has matrix chroma of 2 or less. The combined thickness of the B and BC horizons is at least 6 inches.

The Cd layer has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 to 4. It is prismatic parting to platy, platy or it is massive. Aggregations bounded by planes or zones of weakness are considered inherent in the parent material.

COMPETING SERIES: This is the [illegible] series. Aurelie soils have 18 to 27 percent clay throughout the particle size control section. Monarda and Pilsbury are in closely related families. They have pH less than 5.5 in the subsoil below a depth of 25 cm and Monarda soils have 10 to 18 percent clay in the particle-size control section.

GEOGRAPHIC SETTING: Brayton soils are in depressions and on toeslopes of glaciated uplands. Slopes range from 0 to 25 percent. The soils formed in dense till derived mainly from granite, phyllite, schist, slate, and shale of Wisconsin age. The climate is humid and cool temperate. Mean annual temperature ranges from 3 to 8 degrees C, and mean annual precipitation commonly ranges from 864 to 1219 mm but includes up to 1524 mm in the coastal area of Mt. Desert Island, Maine. The frost-free season ranges from 90 to 160 days. Elevations range from about 2 to 762 m above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Colonel, Dummerston, Dixfield, Fullam, Hubbardton, Lyman, Macomber, Marlow, Peru, Skerry, Taconic, Tunbridge, and Peacham soils. The Colonel, Dixfield, Lyman, Marlow, Peru, Skerry, and Tunbridge soils have spodic horizons, are better drained, and are on higher topographic positions. Peacham soils have a histic epipedon and are in lower topographic positions. The Dummerston, Fullam, Hubbardton, Macomber, and Taconic soils are better drained and are on higher topographic positions.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Poorly drained. A perched water table is above the dense substratum from autumn through spring. Estimated saturated hydraulic conductivity is moderately high or high in the solum and moderately low or moderately high in the dense substratum.

USE AND VEGETATION: Most areas of this soil are forested. Some areas are cleared and used for hay and pasture. Forest vegetation is mainly red spruce, white spruce, black spruce, balsam fir, eastern white pine, red maple, northern white cedar, and paper birch, yellow birch and hemlock.

DISTRIBUTION AND EXTENT: Connecticut, Maine, Massachusetts, New York, and Vermont. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Essex County, New York, 1954.

REMARKS: After reviewing location, geographic coordiantes changed from USGS Amherst topographic quadrangle; lat. 44 degrees 46 minutes 48 seconds N. and long. 68 degrees 22 minutes 19 seconds W., NAD 27.

Diagnostic horizons and features recognized in this pedon include:

1. Ochric epipedon - the zone from 0 to 18 cm (Oi, Oa and A horizons).
2. Cambic horizon - the zone from 25 to 58 cm (Bg and BC horizons).
3. Densic contact - very firm, dense basal till at a depth of 58 cm.
4. Aeric Feature - both value and chroma of 3 or more in the zone from 41 to 58 (BC horizon).
5. Aquic conditions - redox depletions throughout the subsoil. (Eg, Bg and BC horizons).

The Aurelie series is included in the competing soils section with a previous revision.

Previous remarks June, 2004 revision:
The type location is changed with this revision based on consensus that placement in the shallow family is reflective of the dominant characteristics of the series. It is acknowledged that historically the series exceeded 50 cm to densic contact in some places. The series is re-classified from Epiaquepts to Endoaquepts in accordance with Soil Taxonomy which, in reference to applying keys, stipulates that diagnostic horizons and properties below a densic contact are excluded. It is assumed the depth to bedrock from the mineral surface of this pedon exceeds 152 cm. This soil was previously type located in New York and classified as Coarse-loamy, mixed, nonacid, frigid Aeric Fragiaquepts. The classification was changed as a result of the Northeast Fragipan Study. This series also included somewhat poorly drained soils but has since been restricted to poorly drained.

ADDITIONAL DATA: Source of the data used in establishing taxonomic class and range in characteristics is Maine Agricultural Experiment Station Technical Bulletin 94, September 1979.
Soil Interpretation Record Numbers for the Brayton Series are: Brayton, ME0100; Brayton, stony, ME0101; Brayton bouldery, ME0123; Brayton, variant ME0090.

National Cooperative Soil Survey
U.S.A.


ROBERT VILE SOIL CONSULTING, INC.
P.O. BOX 114 DIXMONT, MAINE 04932
CLASS B HIGH INTENSITY SOIL SURVEY
FOR:
CENTRAL MAINE POWER COMPANY
LOCATION:
CENTRAL MAINE POWER COMPANY CORRIDOR
WEST FORKS, SOMERSET COUNTY, MAINE
FIELD SURVEY: ROBERT VILE
CERTIFIED SOIL SCIENTIST #201
OCTOBER 16, 2018
SCALE 1"=50'
GRAPHIC SCALE
(IN FEET)
1 inch = 50 ft.
LEGEND
= 3/4" IRON REBAR SET WITH RED PLASTIC CAP INSCRIBED K.A. SARGENT PLS 2450 (unless otherwise noted).
= UTILITY POLE
= WETLANDS
= INDEX CONTOUR (NAVD 88 FEET)
= INTERMEDIATE CONTOUR (NAVD 88 FEET)
NOTES
NOTE...1 BOUNDARY AND TOPOGRAPHIC INFORMATION PROVIDED BY SACKETT & BRAKE SURVEY, INC.
NOTE...2 WETLAND DELINEATION PERFORMED BY ROBERT VILE.
SOILS LEGEND
Br - Brayton Series - Poorly Drained
Tb - Tunbridge Series - Well Drained
Ly - Lyman Series - Well Drained
Slope Phases
A : 0% to 3% Slope
B : 3% to 8% Slope
C : 8% to 15% Slope
C : 15% to 40% Slope
TP : Soil Test Pit
: Soil Boundary
Br/A
Soil Series
Slope Phase
STATE OF MAINE
Robert Vile C.S.S. #201
CERTIFIED SOIL SCIENTIST
ROBERT VILE
CSS#201
2018245(WF)-SOILS
BrA
TbA
LyB
TbC
TbB
TbD
LyD
TEST PIT 1
TEST PIT 2
TEST PIT 3
TEST PIT 4
SOIL BORING 5
SOIL BORING 6
pink flagged line (limit of inspection)
GROUND OBSCURED
3/4" iron rebar found 11" tall w/survey cap #2318
3/4" iron rebar found 13" tall w/survey cap #2318
3/4" iron rebar found 27" tall w/survey cap #2318
959.4
935.2
954.2
956.1
949.6
960.8
962.8
966.8
971.3
944.4
971.9
974.5
943.5
943.5
946.5
949.6
941.9
942.2
951.1
964.8
946.9
945.3
948.1
940.4
954.2
874.1
946.5
904.7
894.5
864.6
867.6
884.9
872.6

Class B High Intensity Soil Survey

For

Central Maine Power Company Proposed Electrical Substation

Moxie Gore, ME

Soil Survey completed by Robert Vile Soil Consulting Inc

October 16, 2018

Robert Vile
Licensed Site Evaluator
Certified Soil Scientist

P.O. Box 114, Cates Rd.
Dixmont, ME 04932

Telephone:
(207)234-2451

Date: October 16, 2018

To: Sackett & Brake Survey, Inc.
P.O. Box 207
Skowhegan, Me. 04976

Re: Soil Suitability for a proposed CMP Electrical Substation in Moxie Gore, Me.

Findings: On October 12, 2018 I conducted a Class B High Intensity Soil Survey on the above captioned +- 5 acre parcel. Two different soil series were identified on the parcel. Most of the site is Peru soils. These soils are moderately well drained glacial till soils with little disadvantages for development. The natural slopes on the property are gentle for the most part. The only steep area is just above a small wetland area that contains the Brayton soil series. The forested wetland will require proper permitting if plans are to fill in or disturb the soils in the wetland area. In general I would say the site is suitable for the proposed project.

Sincerely,

Robert G. Vile jr.

Robert G. Vile jr.
C.S.S. # 201
L.S.E. S204

Robert Vile
Licensed Site Evaluator
Certified Soil Scientist

P.O. Box 114, Cates Rd.
Dixmont, ME 04932

Telephone:
(207)234-2451

Date: October 16, 2018

To: Sackett & Brake Survey, Inc.
P.O. Box 207
Skowhegan , Me. 04976

Re: Class B High Intensity Soil Survey of a +- 5 Acre parcel of land located in Moxie Gore, Me. for a Central Maine Power proposed electrical substation.

Findings: On October 12,2018 I investigated the above captioned parcel. The purpose of the investigation was to conduct a Class B High Intensity Soil Survey of the site. The boundaries of the survey were marked by Land surveyors. Soils were described by means of hand shoveled test pits and many soil auger borings do to difficult access for an excavator. The soil test pit locations as well as a two foot contour map at a scale of 1" = 50' were provided by Sackett & Brake Survey, Inc. This soil survey was conducted for the use in planning a Central Maine Power Company proposed electrical substation. This Class B High Intensity Soil Survey was mapped following these minimum standards described in Guidelines For Maine Certified Soil Scientists For Soil Identification And Mapping:

Class B (High Intensity)

1. Map units will not contain dissimilar limiting individual inclusions larger than one acre. Dissimilar limiting inclusions may total more than one acre per map unit delineation, in the aggregate, if not continuous.
2. Scale of 1"=200' or larger.
3. Ground control-test pits for which detailed data is recorded are located by means of compass by chaining, pacing, or taping from known survey points; or other methods of equal or greater accuracy.
4. Base map with 5-foot contour lines.

Two different Soil Series were identified on the parcel. Peru and Brayton soil series. The Peru soils are classified as Coarse-loamy , isotic, frigid Aquic Haplorthods by Soil Taxonomy. These soils are moderately well drained soils that formed in lodgment till on the upland portions of this parcel. Peru soils are deeper than 40 " to bedrock. These soils exist in the forested uplands on this property with slopes ranging from 2 to 40 % . Some what firm basil till was found about 30" below the mineral surface and seasonal water table depths ranged from 18"-24". A typical pedon for this series is described at Test Pit #3. Please see attached test pit logs. Peru soils are a Class C Hydrologic Soil Group.

Surface run-off is medium and permeability is moderate in the upper horizons and moderately slow in the lower horizons. There is no hazard to flooding in the areas mapped Peru on this site. Inclusions which may exist within the Peru map units include the somewhat poorly drained Colonel Series or the Tunbridge Series. The Peru soils will have a very little negative impact on the proposed development.

The Brayton soils are classified Loamy,mixed,active,nonacid,frigid,shallow Aeric Endoaquepts by Soil Taxonomy. These soils are deep, poorly drained glacial till found in a lowland depression on this parcel. Brayton soils are hydric soils and occur within the wetland area on this site. The Brayton soils have thick organic horizons and are very bouldery on this parcel. Seasonal water tables are at the mineral surface and ponding is possible within the wetland area. Brayton soils occur on 0-3% slopes at this site. A typical pedon for this series is described at Test Pit # 1. Please see attached test pit logs. Brayton soils are a Class C Hydrologic Soil Group. Surface run-off is slow to none on this site. Inclusions within the Brayton map unit may be the very poorly drained Peachem Soil Series. The limiting factor of the Brayton soils for this project is the high seasonal water table and they are found in the forested wetland.

The accompanying soil profile descriptions, soil survey map and this soil narrative report dated October 16, 2018 were done in accordance with the standards adopted by the Maine Association of Professional Soil Scientists and presented in the " Guidelines for Maine Certified Soil Scientists for Soil Identification and Mapping" latest revision and prepared by Robert G. Vile jr. " Certified Soil Scientist # 201.

If you have any questions regarding the investigation please feel free to contact me at the above number.

Sincerely,

Robert G Vile jr

Robert G. Vile jr.
C.S.S. # 201
L.S.E. S204

STATE OF MAINE
Robert Vile
C.S.S. #201
CERTIFIED
SOIL SCIENTIST

FORM F 1/01

SOIL PROFILE / CLASSIFICATION INFORMATION

DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES

Project Name: Electrical Substation

Applicant Name: Central Maine Power Co.

Project Location (municipality): Moxie Gore

Exploration Symbol: #1 ■ Test Pit ☐ Boring

15 " Organic horizon thickness Ground surface elev. ___

Depth (inches)	Texture	Consistency	Color	Mottling
0–18	Bouldery Organic material	Friable	Black	Wet organic material
18–24	Sandy loam (bouldery)		Grey	
	15" Limit of excavation (free water)			

Soil data by S.E.: Soil Profile 3 · Classification Condition E · Slope 0 Percent · Limiting Factor 0 Depth · ■ Groundwater ☐ Restrictive Layer ☐ Bedrock

Soil data by S.S.: Soil series/phase name: Brayton · ■ Hydric ☐ Non-hydric · Hydrologic Soil Group C

Exploration Symbol: #2 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ___

Depth (inches)	Texture	Consistency	Color	Mottling
0–21	Gravely fine sandy loam	Friable	Reddish grey / Strong brown / Yellowish brown	None
21–32	Stoney gravely loam		Light olive brown	Common distinct
32–42		Firm in place		

Soil data by S.E.: Soil Profile 3 · Classification Condition C · Slope ___ Percent · Limiting Factor 18 Depth · ■ Groundwater ☐ Restrictive Layer ☐ Bedrock

Soil data by S.S.: Soil series/phase name: Peru · ☐ Hydric ■ Non-hydric · Hydrologic Soil Group C

Exploration Symbol: #3 ■ Test Pit ☐ Boring

2 " Organic horizon thickness Ground surface elev. ___

Depth (inches)	Texture	Consistency	Color	Mottling
0–27	Stoney gravely fine sandy loam	Friable	Grey / Strong brown / Yellowish brown	None
27–42	↓	Firm in place	Light olive brown	Common distinct

Soil data by S.E.: Soil Profile 3 · Classification Condition C · Slope ___ Percent · Limiting Factor 24 Depth · ■ Groundwater ☐ Restrictive Layer ☐ Bedrock

Soil data by S.S.: Soil series/phase name: Peru · ☐ Hydric ■ Non-hydric · Hydrologic Soil Group C

Exploration Symbol: #4 ■ Test Pit ☐ Boring

0 " Organic horizon thickness Ground surface elev. ___

Depth (inches)	Texture	Consistency	Color	Mottling
0–27	Stoney gravely sandy loam	Friable	Yellowish brown	None
27–42	↓	Firm in place	Light olive brown	Common distinct

Soil data by S.E.: Soil Profile 3 · Classification Condition C · Slope ___ Percent · Limiting Factor 24 Depth · ■ Groundwater ☐ Restrictive Layer ☐ Bedrock

Soil data by S.S.: Soil series/phase name: Peru · ☐ Hydric ■ Non-hydric · Hydrologic Soil Group C

INVESTIGATOR INFORMATION AND SIGNATURE

Signature: Robert G. Vile Jr.

Date: 10-15-18

Name Printed/typed: Robert G. Vile jr.

Cert/Lic/Reg. # 55 / 201

Title: ■ Licensed Site Evaluator ☐ Certified Geologist ■ Certified Soil Scientist ☐ Other:

STATE OF MAINE · Robert Vile C.S.S. #201 · CERTIFIED SOIL SCIENTIST

affix professional seal

LOCATION PERU NH+MA ME NY VT

Established Series
Rev. HRM-RFL-DHZ
06/2016

PERU SERIES

The Peru series consists of moderately well drained soils that formed in loamy lodgment till on hills and mountains in glaciated uplands. They are moderately deep to a dense substratum and very deep to bedrock. Estimated saturated hydraulic conductivity is moderately high or high in the solum, and moderately low or moderately high in the dense substratum. Slope ranges from 0 to 60 percent. Mean annual precipitation is about 1180 mm, and mean annual temperature is about 6 degrees C.

TAXONOMIC CLASS: Coarse-loamy, isotic, frigid Aquic Haplorthods

TYPICAL PEDON: Peru fine sandy loam, on a north facing, 15 percent slope in a very stony wooded area. (Colors are for moist soil unless otherwise noted.)

Oe--0 to 3 cm; black (10YR 2/1) moderately decomposed plant material; very friable; very strongly acid (pH 4.9); abrupt smooth boundary. (O horizon thickness is 0 to 10 cm.)

A--3 to 13 cm; dark brown (7.5YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many very fine and fine and few coarse roots; 5 percent rock fragments; very strongly acid (pH 4.8); abrupt wavy boundary. (0 to 10 cm thick)

E--13 to 15 cm; light brownish gray (10YR 6/2) fine sandy loam; weak medium granular structure; friable; common fine roots; 5 percent rock fragments; very strongly acid (pH 4.8); abrupt broken boundary. (0 to 10 cm thick)

Bs1--15 to 18 cm; dark brown (7.5YR 3/4) fine sandy loam; weak fine granular structure; friable; common fine and few coarse roots; 5 percent rock fragments; very strongly acid (pH 5.0); abrupt broken boundary.

Bs2--18 to 33 cm; strong brown (7.5YR 4/6) fine sandy loam; weak fine granular structure; friable; common fine and few coarse roots; 5 percent rock fragments; very strongly acid (pH 5.0); clear wavy boundary.

Bs3--33 to 46 cm; dark yellowish brown (10YR 4/6) fine sandy loam; weak medium subangular blocky structure; friable; common fine roots; 5 percent rock fragments; strongly acid (pH 5.2); abrupt wavy boundary. (Combined thickness of the Bs horizon is 7 to 38 cm).

BC--46 to 54 cm; dark yellowish brown (10YR 4/4) fine sandy loam; weak fine subangular blocky structure; friable; few fine roots; common fine faint olive brown (2.5Y 4/3) iron depletions in the matrix; 5 percent rock

fragments; strongly acid (pH 5.2); abrupt smooth boundary. (0 to 38 cm thick)

Cd1--54 to 94 cm: olive brown (2.5Y 4/3) fine sandy loam; 85 percent moderate medium plates and 15 percent sandy lenses; firm; common medium faint olive gray (5Y 4/2) iron depletions in the matrix; 5 percent rock fragments; strongly acid (pH 5.2); clear wavy boundary.

Cd2--94 to 165 cm; olive gray (5Y 4/2) fine sandy loam; 95 percent moderate thick plates and 5 percent sandy lenses; firm; common medium faint olive brown (2.5Y 4/3) masses of iron accumulation on faces of peds; 5 percent rock fragments; strongly acid (pH 5.2).

TYPE LOCATION: Merrimack County, New Hampshire; Town of New London; located about 275 meters west of County Road on Northwood Lane, and 35 meters south of the road; USGS Sunapee Lake North, NH topographic quadrangle; latitude 43 degrees 24 minutes 04 seconds N. and longitude 72 degrees 01 minutes 17 seconds W., NAD 83.

RANGE IN CHARACTERISTICS: The thickness of the mineral solum and depth to densic materials from the mineral surface range from 50 to 100 cm. Depth to bedrock is greater than 150 cm. Texture is typically fine sandy loam, sandy loam, or loam in the fine-earth fraction but includes silt loam and very fine sandy loam in the upper part of the solum. The weighted average of clay in the particle-size control section is 10 percent or less. The silt content in the solum and underlying till averages less than 50 percent, but ranges to 50 percent or more in the upper 25 cm of the solum. Rock fragments are dominantly gravel with some cobbles and stones and typically range from 5 to 30 percent throughout the mineral soil. Some pedons have horizons with less than 5 percent rock fragments. Reaction ranges from extremely acid to slightly acid in the solum, and from very strongly acid to slightly acid in the substratum.

The O horizons, where present, consist of slightly, moderately, and/or highly decomposed organic material. The Oe and Oa horizons have hue of 2.5YR to 10YR, value of 2 to 4, and chroma of 1 to 4.

The A, or Ap horizon where present, has hue of 5YR to 10YR and value and chroma of 2 to 4.

The E horizon is neutral or has hue of 5YR to 2.5Y, value of 4 to 7, and chroma of 0 to 2.

The Bhs horizon, where present, is up to 13 cm thick and has hue of 2.5YR to 10YR, a value of 2 to 3, and a chroma of 1 to 3.

The Bs horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 3 to 8.

The BC horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 2 to 6.

Some pedons have an E or E' horizon below the B horizon. It has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 or 3. Typically, it has a coarser texture than the overlying horizon.

Some pedons have a friable C horizon up to 20 cm thick that has color and texture similar to the underlying Cd horizon.

The Cd horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 2 to 4. Consistence is firm or very firm. Arrangement of soil particles into plates is considered to be geogenic. Loose or fri ble segregated sand lenses with a horizontal orientation compose up to 20 percent of the densic materials. The lenses are typically coarse, medium, or fine sand ranging from 2 to 25 mm thick.

COMPETING SERIES: These are the Chesuncook, Crary, Dixmont, Howland, Ragmuff, Skerry, Sunapee, and Worden series. Chesuncook soils have a weighted average of more than 10 percent clay in the particle-size control section. Crary soils have a mantle of eolian or water deposited sediments ranging from 40 to 100 cm thick over till. Dixmont and Sunapee soils are formed in loamy supraglacial till and do not have densic materials within 100 cm of the mineral soil surface. Howland soils have a weighted average of more than 50 percent silt in the particle-size control section. Ragmuff soils are moderately deep to bedrock. Skerry soils have more than 20% sandy lenses in the Cd horizon. Worden soils are somewhat poorly drained.

GEOGRAPHIC SETTING: Peru soils are on nearly level to steep slopes in glaciated uplands. Typically they are on linear or convex areas of backslopes, footslopes, and toeslopes, but they also occur in concave positions. The soils formed in loamy lodgment till derived mainly from schist, gneiss, phyllite, and granite. Slope ranges from 0 to 60 percent. The mean annual precipitation is 790 to 1640 mm, and the mean annual temperature is 2 to 7 degrees C. The frost-free period ranges from 90 to 160 days. Elevation ranges from about 2 to 800 meters above sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Berkshire, Brayton, Cabot, Colonel, Lyman, Marlow, Monadnock, Peacham, Pillsbury, Sunapee, and Tunbridge soils. Berkshire, Lyman, Monadnock, Sunapee, and Tunbridge soils are formed in supraglacial till and do not have densic materials. Additionally, Lyman soils are shallow to bedrockk, and Tunbridge soils are moderately deep to bedrock. Peru soils are in a drainage sequence with the well drained Marlow soils, somewhat poorly drained Colonel soils, poorly drained Brayton, Cabot, and Pillsbury soils, and very poorly drained Peacham soils.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Moderately well drained. Estimated saturated hydraulic conductivity is moderately high or high in the solum, and moderately low or moderately high in the dense substratum.

USE AND VEGETATION: Most areas are wooded. The common trees are sugar maple, eastern white pine, balsam fir, red spruce, white spruce, white ash, yellow birch, paper birch, eastern hemlock, American beech, and red pine. Areas cleared of stones are used mainly for hay and pasture and some cultivated crops.

DISTRIBUTION AND EXTENT: Maine, Massachusetts, New Hampshire, New York, and Vermont. The soils of this series are extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Berkshire County, Massachusetts, 1923.

REMARKS: 1. Dixfield soils were recorrelated to Peru soils as part of the national Soil Data Join Recorrelation initiative. Revisions to the Peru Range in Characteristics incorporate values from the Dixfield Official Series Description. As a result of this revision to Peru, the Dixfield series status has been changed to

inactive.

2. Diagnostic horizons and features recognized in this pedon are:

a. Ochric epipedon - the zone from 0 to 15 cm (Oe, A, and E horizons).
b. Spodic horizon - the zone from 15 to 33 cm (Bs1 and Bs2 horizons).
c. Aquic conditions - redoximorphic features at 43 cm below the mineral soil surface (BC, Cd1, and Cd2 horizons).
d. Densic materials - the zone from 54 to 165 cm (Cd1 and Cd2 horizons).

ADDITIONAL DATA: Characterization data for Peru and similar soils is available through the National Cooperative Soil Survey Soil Characterization Database: http://ncsslabdatamart.sc.egov.usda.gov/

National Cooperative Soil Survey
U.S.A.

LOCATION BRAYTON ME+CT MA NY VT

Established Series
Rev. KJL-DEW-ANA
09/2013

BRAYTON SERIES

The Brayton series consists of very deep, poorly drained soils on toeslopes and depressions of glaciated uplands. These soils formed in dense till. Saturated hydraulic conductivity is moderately high or high in the solum and moderately low or moderately high in the dense substratum. Slope ranges from 0 to 25 percent. Mean annual temperature is about 7 degrees C, and mean annual precipitation is about 1092 mm.

TAXONOMIC CLASS: Loamy, mixed, active, nonacid, frigid, shallow Aeric Endoaquepts

TYPICAL PEDON: Brayton fine sandy loam, in a gently sloping, very stony forested area. (Colors are for moist soil unless otherwise stated.)

Oi--0 to 2 cm; slightly decomposed leaves, needles and twigs.

Oa--2 to 13 cm; black (5YR 2/1) highly decomposed organic material; weak very fine granular structure; very friable, many very fine, fine and medium, and common coarse roots; extremely acid; abrupt wavy boundary. (Combined thickness of the O horizons is 0 to 15 cm.)

A--13 to 18 cm; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 6/1) dry; weak fine and medium granular structure; very friable; many very fine, fine and medium, and common coarse roots; 10 percent rock fragments; extremely acid; abrupt wavy boundary. (0 to 15 cm thick)

Eg--18 to 25 cm; gray (10YR 5/1) gravelly fine sandy loam; few medium distinct pinkish gray (5YR 6/2) masses of iron accumulation and few fine faint gray (10YR 6/1) iron depletions; weak very fine subangular blocky structure; friable; many very fine and fine, and common medium roots; 20 percent rock fragments; extremely acid; abrupt wavy boundary. (0 to 10 cm thick)

Bg--25 to 41 cm; grayish brown (2.5Y 5/2) fine sandy loam; weak very fine and fine subangular blocky structure; friable; common very fine and fine roots; many medium prominent dark yellowish brown (10YR 4/6) masses of iron accumulation and few fine faint gray (10YR 6/1) iron depletions; 10 percent rock fragments; strongly acid; clear wavy boundary. (13 to 51 cm thick)

BC--41 to 58 cm; light olive brown (2.5Y 5/4) fine sandy loam; weak thin platy structure; firm; many medium faint dark yellowish brown (10YR 4/4) masses of iron accumulation and few fine prominent gray (10YR 6/1) iron depletions; 10 percent rock fragments; moderately acid; clear wavy boundary. (0 to 25 cm thick)

Cd1--58 to 74 cm; olive (5Y 5/3) fine sandy loam; moderate thin and medium platy; very firm; many medium prominent yellowish brown (10YR 5/6) and common medium prominent dark yellowish brown masses of iron accumulation, few fine prominent gray (10YR 6/1) iron depletions; 10 percent rock fragments; slightly acid; clear wavy boundary.

Cd2--74 to 165 cm; olive (5Y 4/3) fine sandy loam; massive; very firm; common medium distinct dark yellowish brown (10YR 4/4) masses of iron accumulation, few fine prominent gray (10YR 6/1) iron depletions; 10 percent rock fragments; slightly acid.

TYPE LOCATION: Hancock County, Maine; town of Mariaville; off Maine Route 181, about 1.3 miles north of the bridge spanning the West Branch of Union River, about 500 feet southeast of highway; USGS Amherst topographic quadrangle; lat. 44 degrees 46 minutes 47 seconds N. and long. 68 degrees 22 minutes 15 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: The combined thickness of the A, E, B and BC horizons is 25 to 50 cm. Depth to bedrock from the mineral soil surface is more than 152 cm. Reaction ranges from extremely acid to moderately acid in the A and Eg horizons and from strongly acid to slightly acid in the B and BC horizons. One or more subhorizons in the subsoil below a depth of 25 cm have pH greater than 5.5. The Cd layer ranges from moderately acid to neutral. Rock fragments in the mineral soil range from 5 to 35 percent by volume. The proportions of rock fragments are about 80 percent gravel, 15 percent cobbles, and 5 percent stones. Some pedons have channers and flagstones. Stones and boulders cover from 0 to 25 percent of the surface. Textures of the solum are silt loam, loam, very fine sandy loam, fine sandy loam, or sandy loam in the fine-earth fraction with less than 10 percent clay. The substratum textures are loam, very fine sandy loam, fine sandy loam, or sandy loam in the fine-earth fraction with less than 10 percent clay. Consistence is very friable to firm in the solum and firm or very firm in the dense substratum.

The O horizon, where present, is fibric, hemic and/or sapric material.

The A or Ap horizon, where present, has hue of 10YR to 5Y, value of 2 to 4, and chroma of 1 to 4. Structure is granular.

The Eg horizon, where present, has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 or 2.

The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It has subangular blocky, granular or platy structure.

The BC horizon, where present, has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 to 4. It has subangular blocky or platy structure.

One or more subhorizon in the subsoil has matrix chroma of 2 or less. The combined thickness of the B and BC horizons is at least 6 inches.

The Cd layer has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 to 4. It is prismatic parting to platy, platy or it is massive. Aggregations bounded by planes or zones of weakness are considered inherent in the parent material.

COMPETING SERIES: This is the [illegible] series. Aurelie soils have 18 to 27 percent clay throughout the particle size control section. Monarda and Pillsbury are in closely related families. They have pH less than 5.5 in the subsoil below a depth of 25 cm and Monarda soils have 10 to 18 percent clay in the particle-size control section.

GEOGRAPHIC SETTING: Brayton soils are in depressions and on toeslopes of glaciated uplands. Slopes range from 0 to 25 percent. The soils formed in dense till derived mainly from granite, phyllite, schist, slate, and shale of Wisconsin age. The climate is humid and cool temperate. Mean annual temperature ranges from 3 to 8 degrees C, and mean annual precipitation commonly ranges from 864 to 1219 mm but includes up to 1524 mm in the coastal area of Mt. Desert Island, Maine. The frost-free season ranges from 90 to 160 days. Elevations range from about 2 to 762 m above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Colonel, Dummerston, Dixfield, Fullam, Hubbardton, Lyman, Macomber, Marlow, Peru, Skerry, Taconic, Tunbridge, and Peacham soils. The Colonel, Dixfield, Lyman, Marlow, Peru, Skerry, and Tunbridge soils have spodic horizons, are better drained, and are on higher topographic positions. Peacham soils have a histic epipedon and are in lower topographic positions. The Dummerston, Fullam, Hubbardton, Macomber, and Taconic soils are better drained and are on higher topographic positions.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Poorly drained. A perched water table is above the dense substratum from autumn through spring. Estimated saturated hydraulic conductivity is moderately high or high in the solum and moderately low or moderately high in the dense substratum.

USE AND VEGETATION: Most areas of this soil are forested. Some areas are cleared and used for hay and pasture. Forest vegetation is mainly red spruce, white spruce, black spruce, balsam fir, eastern white pine, red maple, northern white cedar, and paper birch, yellow birch and hemlock.

DISTRIBUTION AND EXTENT: Connecticut, Maine, Massachusetts, New York, and Vermont. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Essex County, New York, 1954.

REMARKS: After reviewing location, geographic coordiantes changed from USGS Amherst topographic quadrangle; lat. 44 degrees 46 minutes 48 seconds N. and long. 68 degrees 22 minutes 19 seconds W., NAD 27.

Diagnostic horizons and features recognized in this pedon include:
1. Ochric epipedon - the zone from 0 to 18 cm (Oi, Oa and A horizons).
2. Cambic horizon - the zone from 25 to 58 cm (Bg and BC horizons).
3. Densic contact - very firm, dense basal till at a depth of 58 cm.
4. Aeric Feature - both value and chroma of 3 or more in the zone from 41 to 58 (BC horizon).
5. Aquic conditions - redox depletions throughout the subsoil. (Eg, Bg and BC horizons).

The Aurelie series is included in the competing soils section with a previous revision.

Previous remarks June, 2004 revision:
The type location is changed with this revision based on consensus that placement in the shallow family is reflective of the dominant characteristics of the series. It is acknowledged that historically the series exceeded 50 cm to densic contact in some places. The series is re-classified from Epiaquepts to Endoaquepts in accordance with Soil Taxonomy which, in reference to applying keys, stipulates that diagnostic horizons and properties below a densic contact are excluded. It is assumed the depth to bedrock from the mineral surface of this pedon exceeds 152 cm. This soil was previously type located in New York and classified as Coarse-loamy, mixed, nonacid, frigid Aeric Fragiaquepts. The classification was changed as a result of the Northeast Fragipan Study. This series also included somewhat poorly drained soils but has since been restricted to poorly drained.

ADDITIONAL DATA: Source of the data used in establishing taxonomic class and range in characteristics is Maine Agricultural Experiment Station Technical Bulletin 94, September 1979.
Soil Interpretation Record Numbers for the Brayton Series are: Brayton, ME0100; Brayton, stony, ME0101; Brayton bouldery, ME0123; Brayton, variant ME0090.

National Cooperative Soil Survey
U.S.A.

ROBERT VILE SOIL CONSULTING, INC.
P.O. BOX 114 DIXMONT, MAINE 04932

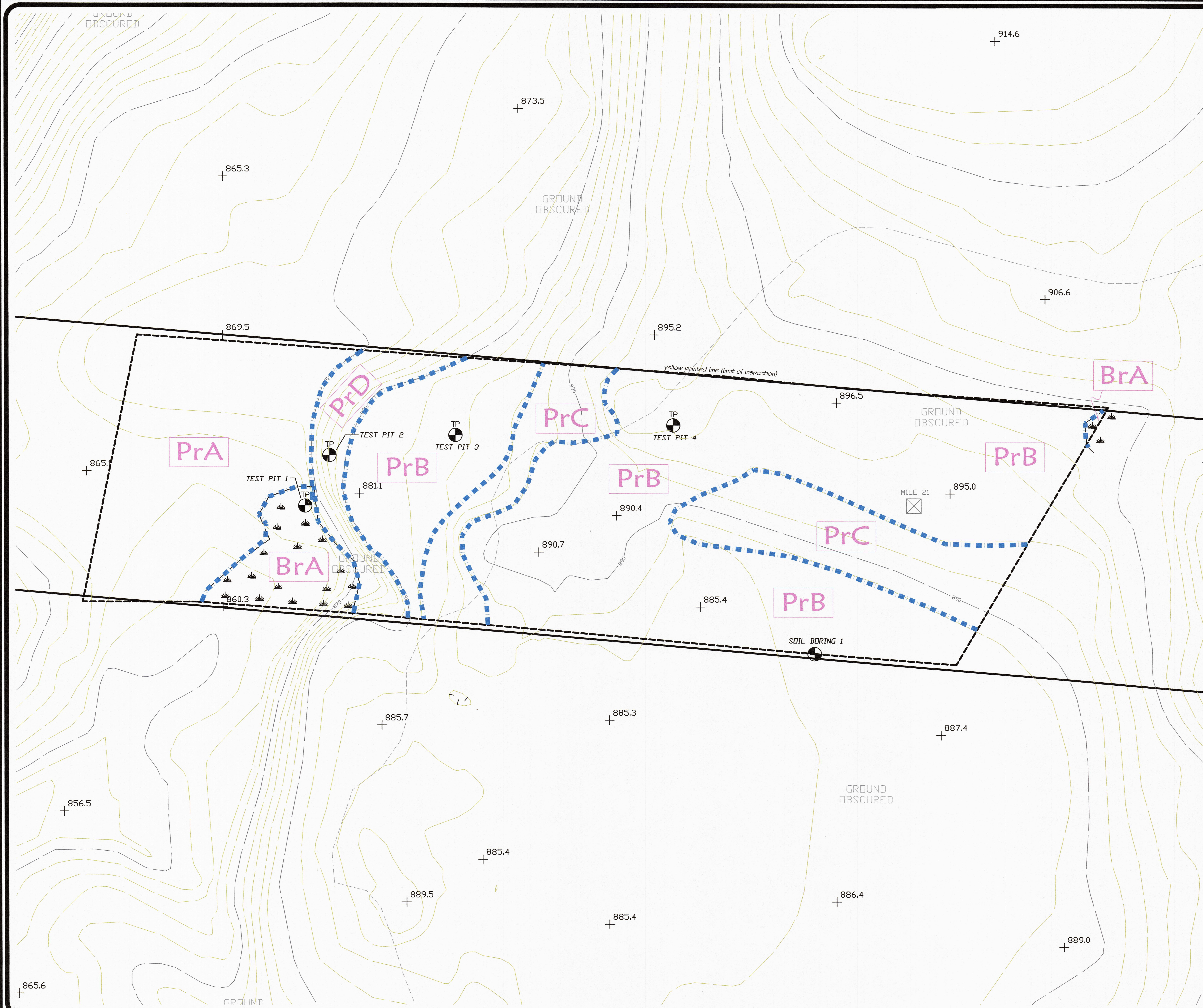
CLASS B HIGH INTENSITY SOIL SURVEY

FOR:

CENTRAL MAINE POWER COMPANY

LOCATION:
CENTRAL MAINE POWER COMPANY CORRIDOR
MOXIE GORE, SOMERSET COUNTY, MAINE

FIELD SURVEY: ROBERT VILE	OCTOBER 16, 2018
CERTIFIED SOIL SCIENTIST #201	SCALE 1"=50'



GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.

LEGEND

● = 3/4" IRON REBAR SET WITH RED PLASTIC CAP INSCRIBED S.W. GOULD PLS 2318 (unless otherwise noted).

= UTILITY POLE

= WETLANDS

= INDEX CONTOUR (NAVD 88 FEET)

= INTERMEDIATE CONTOUR (NAVD 88 FEET)

NOTES

NOTE...1 BOUNDARY AND TOPOGRAPHIC INFORMATION PROVIDED BY SACKETT & BRAKE SURVEY, INC.

NOTE...2 WETLAND DELINEATION PERFORMED BY ROBERT VILE.

SOILS LEGEND

Br - Brayton Series - Poorly Drained
Pr - Peru Series - Moderately Well Drained

Slope Phases

A : 0% to 3% Slope
B : 3% to 8% Slope
C : 8% to 15% Slope
D : 15% to 40% Slope

Br/A — Soil Series / Slope Phase

TP : Soil Test Pit
: Soil Boundary

STATE OF MAINE
Robert Vile
C.S.S. #201
CERTIFIED SOIL SCIENTIST

ROBERT VILE
CSS#201

2018245(MG)-SOILS

2018245 FULL restore.dwg 2018245 MOXIE 10/16/2018 15:15:09 1 : 1

REPORT

18-0345 S

April 19, 2019

Explorations and Geotechnical Engineering Services

Proposed NECEC Kennebec River Underground Cable & HDD
Somerset County
West Forks Plantation & Moxie Gore, Maine

Prepared For:
Central Maine Power Company
Attention: Adam Desrosiers – Program Manager - NECEC
83 Edison Drive
Augusta, Maine 04336

S.W.COLE ENGINEERING, INC.

- Geotechnical Engineering
- Construction Materials Testing and Special Inspections
- GeoEnvironmental Services
- Test Boring Explorations

Prepared By:
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18-0345 S

April 19, 2019

Central Maine Power Company
Attention: Adam Desrosiers – Program Manager - NECEC
83 Edison Drive
Augusta, Maine 04336

Subject: Explorations and Geotechnical Engineering Services
Proposed NECEC Kennebec River
Underground Cable & HDD
Somerset County
West Forks Plantation and Moxie Gore, Maine

Dear Adam:

In accordance with our revised Proposal, dated September 24, 2018, we have performed subsurface explorations for the subject project. This report summarizes our findings and geotechnical recommendations and its contents are subject to the limitations set forth in Appendix A.

1.0 INTRODUCTION

1.1 Scope and Purpose

The purpose of our services was to obtain subsurface information at the site in order to develop geotechnical recommendations relative to foundations and earthwork associated with the proposed termination stations, provide field soil resistivity testing data and provide subsurface information at certain locations along the proposed Horizontal Directional Drilling (HDD) line. Our scope of services included test boring explorations, soils and rock laboratory testing, field testing, a limited geotechnical analysis of the subsurface findings and preparation of this report. A report summarizing our field soil resistivity services has been submitted under separate cover.

1.2 Site and Proposed Construction

We understand Central Maine Power (CMP) Company is considering an underground electric transmission line crossing below the Kennebec River as part of the New England Clean Energy Connect (NECEC) Project. We understand the underground line will be installed using HDD methods. Based on the provided site plans, we understand a 320kv overhead HVDC transmission line will enter the HDD site on the east side of the Kennebec River at about Project Station 0+00 (Moxie Gore Termination Station) and continue below ground and beneath the Kennebec River to about Station 37+00 (West Forks Termination Station) before exiting the HDD site as an overhead line. We understand the termination station yards will be about 135 feet by 135 feet in plan dimensions. The existing ground surface at the Moxie Gore station varies from about elevation 894 to 890 feet, east to west and the proposed station pad elevation is 896 feet, requiring minor fills. The existing ground surface at the West Forks station varies from about elevation 960 to 932 feet, northeast to southwest and the proposed station pad is 946, requiring tapered cuts of about 14 feet and tapered fills approaching 14 feet. We understand the yard areas will be constructed with 2H:1V side slopes and surfaced with 6 inches of crushed aggregate topping overlying 18 inches of gravel base material overlying compacted subgrade fill (as needed) overlying native, undisturbed non-organic soils. Drainage swales are planned around the station yards. Access roads are proposed on the northerly side of each station yard with sections consisting of 3 inches of gravel surface overlying 15 inches of MaineDOT Type A gravel base.

Based on limited information available at this time, we anticipate the termination stations will include new equipment structures (transformers, dead-end, switchgear and steel pole structures) and possibly a control building. We understand spread footings, surficial concrete pads, mat foundations with rock anchors and drilled shafts are being considered for equipment foundation and tower support. Since the stations are still in concept design, details regarding the proposed equipment and structures, including sizing, locations and structural loading, are unknown at this time.

We understand the proposed HVDC line will be placed in a 48 inch diameter HDD borehole that will be about 3700 linear feet in plan view. We understand the HDD borehole will be drilled at depths varying from about 30 to 80 feet below the existing ground surface and about 80 to 90 feet below the river bottom.

The current site conditions on each side of the river consist of moderate to thickly wooded forest with ground elevations sloping down to the river from approximately elevation 890 feet on the east side and 950 feet on the west side down to about elevation 620 feet at the river's edge. Slopes become progressively steeper approaching the river with the lower elevations being about 2H:1V or steeper.

Proposed station and HDD locations as well as existing and proposed grades are shown on the "Exploration Location Plans" attached in Appendix B.

2.0 EXPLORATION AND TESTING

2.1 Explorations

Five test borings (BH-1 through BH-5) and were made at the site during the period of October 30 through November 30, 2018 by S. W. Cole Explorations, LLC. The exploration locations were selected by CMP and TRC (project engineer) and established in the field by CMP, Comprehensive Land Technology (CLT) and S. W. Cole Engineering, Inc. (S.W.COLE) with mapping grade GPS equipment using coordinates provided by others. Cutting, clearing and erosion control, where needed, was provided by CLT under subcontract to CMP. The approximate exploration locations are shown on the "Exploration Location Plans" attached in Appendix B. Logs of the explorations and a key to the notes and symbols used on the logs are attached in Appendix C. The elevations shown on the logs were estimated based on topographic information shown on the "Exploration Location Plans". Photos of recovered rock core are also attached in Appendix C.

Three inch diameter PVC casing was installed at borings BH-1 and BH-5 from the bedrock surface up to about 3 feet above the ground surface to maintain an open borehole for later use by CMP.

2.2 Field Testing

The test borings were drilled using cased wash-boring and NQ rock coring techniques. The soils were sampled at 2 to 5 foot intervals using a split-spoon sampler and Standard Penetration Testing (SPT) methods. SPT blow count results are shown on the logs. Rock coring was performed at each boring using a NQ2 core bit. At several borings, a roller bit was used to penetrate the surface of the bedrock prior to coring.

Bulk soil samples were obtained at borings BH-1 through BH-5 for geotechnical and analytical laboratory soil testing.

2.3 Laboratory Testing

2.3.1 Geotechnical Laboratory Testing

Soil samples obtained from the explorations were returned to our laboratory for further classification and testing. Moisture content test results are noted on the exploration logs. Laboratory soil gradation and moisture-density test results are attached in Appendix D. Rock core physical properties, including rock type, RQD (Rock Quality Designation), fractures, foliation, Mohs hardness and degree of weathering are also noted on the logs. Eleven rock core samples were provided to GeoTesting Express for laboratory rock core compression (ASTM D-7012C) and unit weight testing under subcontract to S.W.COLE. These rock core samples were selected by S.W.COLE in collaboration with CMP and TRC as well as estimated depths to the HDD line. The test results are attached in Appendix D.

2.3.2 Laboratory Soil Chemistry, Soil and Rock Thermal Conductivity Testing

Soil Chemistry: Five soil samples; one from each exploration location, were submitted to Alpha Analytical Services for determination of pH (EPA SW846-9045), water soluble chloride content (EPA SW846-9251) and water soluble sulfate content (EPA SW846-9038) testing. Results of the pH and water soluble chloride and sulfate testing as well as sulfate exposure classifications in accordance with ACI 318 Table 4.3.1 are included in Appendix D and summarized in the following table:

Exploration/ sample interval	pH Testing	Chloride Testing (ppm)	Sulfate Testing (ppm)	Sulfate Exposure Classification (ACI 318 Table 4.3.1)
BH-1 / 2'-4''	6.0	< PQL	< PQL	Negligible
BH-2 / 0.4'-2''	7.5	< PQL	< PQL	Negligible
BH-3 / 2'-5'	5.3	22	< PQL	Negligible
BH-4 / 1'-2.5'	7.0	< PQL	< PQL	Negligible
BH-5 / 5'-7'	6.4	< PQL	< PQL	Negligible

Notes
ppm = parts per million
PQL – Procedure Quantification Limit
PQL for chloride testing is 20 ppm
PQL for sulfate testing is 10 ppm

Soil Thermal Conductivity: Five bulk soil samples, one from each boring location, were collected and shipped to Geotherm USA by S.W,COLE for thermal conductivity testing The soil thermal conductivity testing was performed under contract to TRC and specific sample locations/depths were selected by Geotherm USA. Results of this testing have been provided by TRC under separate cover.

Rock Thermal Conductivity: Fourteen rock core samples were collected and shipped to Geotherm USA by S.W.COLE for laboratory thermal conductivity testing. The rock thermal conductivity testing was performed under contract to TRC and specific sample locations/depths were selected by Geotherm USA. Results of this testing have been provided by TRC under separate cover.

2.3.3 Additional Laboratory Rock Testing

As requested, additional samples of rock core were shipped to GeoTesting Express for laboratory testing. The additional testing included Bulk Density and Compressive Strength (ASTM D7012C), unit weight (ASTM D4543), Abrasiveness (ASTM D7625), Slake Durability (ASTM D4644) and Rock Drillability (NTNU/SINTEF 13A-98). The results are attached in Appendix D.

3.0 SUBSURFACE CONDITIONS

3.1 Soil and Bedrock

In general, the explorations encountered a soils profile consisting of forest duff and topsoil with roots overlying medium dense silty sand with varying amounts of gravel (borings BH-1 and BH-4) overlying either bedrock or medium dense to dense brown sand and silt with varying amounts of gravel and cobbles with some boulders (glacial till) overlying bedrock. The forest duff, topsoil and soils with roots varies from about 2 to 3 feet in thickness at the explorations. Where encountered, the silty sand extends to depths of about 2 to 4 feet and the glacial till varies in thickness from about 0 to 8 feet. Highly weathered/decomposed bedrock (saprolite) was encountered at borings BH-1 and BH-5 below the glacial till and prior to encountering more competent bedrock. A 2 foot thick zone of saprolite was encountered at a depth of about 9 feet at boring BH-1 and a 4.5 foot thick zone was encountered at a depth of about 19.5 feet below the existing ground surface at boring BH-5. Approximate depths and corresponding elevations of apparent competent bedrock are summarized below.

APPARENT DEPTH/ELEVATION TO BEDROCK AND DEPTH/ELEVATION OF BOTTOM BORING			
Exploration	**Approximate Ground Surface Elevation (ft)**	**Approximate Depth (Elevation) to Bedrock (ft)**	**Approximate Depth (Elevation) to Bottom of Boring (ft)**
BH-1	947	11 (936)	30 (917)
BH-2	915	8.2 (906)	100 (815)
BH-3	626	8.4 (617.6)	111.5 (514.5)
BH-4	856	4 (852)	193.4 (662.6)
BH-5	894	24 (870)	30 (864)

Note: Depths to bedrock do not include the saprolite layers encountered at BH-1 and BH-5 (depths in table are to apparent competent bedrock). Photos of the recovered bedrock core are attached in Appendix C.

Not all the strata were encountered at each exploration; refer to the attached logs in Appendix C for more detailed subsurface information.

3.2 Groundwater

The soils encountered at the test borings were moist to wet from the ground surface. Saturated soils were encountered at depths varying from about 3 to 10 feet. Depths to groundwater in the open boreholes after drilling were measured at about 7.6, 45, 4, 21.8 and 3.7 feet below the existing ground surface at BH-1 through BH-5, respectively. Long term groundwater information is not available. It should be anticipated that groundwater levels will fluctuate seasonally, particularly in response to the water level of the Kennebec River, periods of snowmelt and precipitation, as well as changes in site use.

3.3 Geological Conditions

The Maine Geological Survey (MGS) *Surficial Geologic Map of Maine* (Thompson and Borns, 1985) depicts surficial sediments in the project area to consist mostly of glacial till (mixture of sand, silt, clay and stones), with zones of glacial outwash (sand and gravel) and eskers (gravel and sand) immediately adjacent to the Kennebec River. The soil samples collected at the boring locations are generally consistent with the MGS surficial sediment mapping.

The MGS *Preliminary Bedrock Geology of The Forks Quadrangle* map (Burroughs and Marvinney, 1991) depicts several different bedrock formations in the project area, including: Dead River Formation (slate and phyllite); Hurricane Mountain Formation (slate and meta-siltstone); Hildreth's Formation (calcareous sulfidic slate); The Forks Formation (dolostone, limestone and calcareous siltstone); and Carrabassett Formation (slate). The bedrock core collected at the five boring locations is generally consistent with the MGS mapping. In general, the core from BH-1 consists of phyllite; the core from BH-2 consists of calcareous siltstone; the core from BH-3 consists of slate and phyllite; the core from BH-4 consists of slate, calcareous slate and calcareous siltstone with zones of phyllite; and the core from BH-5 consists of slate.

3.4 Seismic – Faulting Data

Seismic activity from two sources can impact a site: ground rupture directly beneath a site, and shaking produced at the site from nearby seismic activity. There are no recorded cases of ground rupture that can be definitely attributed to seismic activity in New England since the glaciers receded more than 10,000 years ago.

The MGS *Earthquakes in Maine* map and narrative (Berry and Marvinney, 2003) indicates that an ancient bedrock fault oriented southwest to northeast exists in the general project area. However, none of the ancient bedrock faults in Maine have been correlated with modern earthquake activity.

3.5 Seismic and Frost Conditions

According to IBC 2015/ASCE 7-16, we interpret the following Seismic Site Classes at the termination stations using the N-Value method for soil (borings BH-1 and BH-5):

- Seismic Site Class B (for foundations on sound bedrock)
- Seismic Site Class D (for foundations on compacted fill or native soil)

We recommend consideration of the following seismic design parameters for the 2,500-year design earthquake:

RECOMMENDED SEISMIC DESIGN PARAMETERS (2,500-year Design Earthquake)		
Peak Ground Acceleration (PGA)	0.2-second Spectral Acceleration (S_s)	1-second Spectral Acceleration (S_1)
0.157	0.23g	0.079

NOTE: Seismic design parameters from USGS accessed December 14, 2018. (https://earthquake.usgs.gov/designmaps/us/application.php)

Liquefiable soils typically consist of loose, fine sands and non-plastic silts below the groundwater table. Based on the subsurface findings, it is our opinion the soils at the termination station sites are not susceptible to liquefaction during a seismic event and therefore the risk of lateral spread and seismic induced settlement are negligible.

The 100-year Air Freezing Index for the West Forks, Maine area is about 2,450 Fahrenheit degree days, which corresponds to a frost penetration depth on the order of 6.0 feet. We recommend foundations exposed to freezing be covered with at least 6.0 feet of soil and unheated slabs be insulated or underlain with 6 feet of non-frost susceptible soil for frost protection.

4.0 EVALUATION AND RECOMMENDATIONS

4.1 General Findings

Based on the subsurface findings and limited project information at this time, the proposed termination station(s) construction appears feasible from a geotechnical standpoint. The principle geotechnical considerations include:

- Bedrock Excavations: Based on the subsurface conditions encountered and the proposed grading information, bedrock excavation is not anticipated at the Moxie Gore station, but should be expected at the West Forks station, particularly in the northeast corner where the most significant cut is planned. Removal will require blasting to achieve the necessary grades.

- Termination Station Pads: Topsoil and organics, soils with roots and disturbed or soft yielding soil must be completely removed from beneath the proposed terminal station pads and embankment areas. We recommend bedrock removal extend to at least 6 feet below finish termination pad grade to allow for a 6 foot thick zone of material including the pad surface (designed by others) to allow for excavations for shallow foundations and subgrade utilities.

- Building Structures: Spread footing foundations and a slab-on-grade floors bearing on properly prepared subgrades appear suitable for the proposed control building. Building footings should bear on at least 12-inches of compacted Structural Fill overlying properly prepared subgrades. On-grade floor slabs for unheated structures should bear on at least 6 feet of compacted Gravel Borrow or Structural Fill overlying properly prepared subgrades.

- Equipment and Structure Foundations: We recommend all lightweight equipment foundations bear on at least 6 feet of compacted Gravel Borrow or Structural Fill overlying properly prepared subgrades. Foundations for heavier, moment carrying structures such as dead end structures are anticipated to be supported by large reinforced concrete mat foundations bearing on compacted Structural Fill overlying properly prepared subgrades, directly on sound, intact bedrock with rock anchors, or on caissons drilled into the bedrock to resist overturning.

- Groundwater: The depth to groundwater upon completion of the borings BH-1 and BH-5 was about 7.5 and 3.5 feet below the existing ground surface, respectively. Excavations below groundwater will require dewatering to help control water levels below excavation grades. Drainage swales will be needed surrounding the yard areas to help provide long-term drainage. Foundation drains are recommended for the control building.

- Reuse of Native Soils: In our opinion, the native, non-organic granular (silty sand and glacial till) soils can likely be reused as Common Borrow for mass embankment fills provided they are at a compactable moisture content at the time of construction. The silty sand and glacial till soils are moisture sensitive and may be difficult to compact when above the optimum moisture content. Therefore, we do not recommend reuse of the native soils during wet and freezing conditions.

- Reuse of Blasted Bedrock: Blasted bedrock can be crushed and processed on-site to create Gravel Borrow, Structural Fill and Crushed Stone needed for construction.

4.2 Site and Subgrade Preparation

We recommend site preparation begin with the construction of an erosion control system to protect adjacent drainage ways and areas outside the construction limits. Surficial organics, topsoil and soils with roots should be completely removed from areas of proposed fill and construction. As much vegetation as possible should remain outside the construction areas to lessen the potential for erosion and site disturbance.

Based on the subsurface findings, the thickness of forest duff, topsoil and soils with roots vary across the sites. The contractor should anticipate areas where roots and soils containing organics will extend several feet into the underlying soil. The methods used by the contractor for removal and the moisture condition of the site will affect the volume of material removal required. Topsoil and organics can likely be stockpiled and screened for reuse as a topsoil layer in landscape areas. Suitability of the topsoil re-use from a nutrient and fertility standpoint should be evaluated by soil testing prior to its use.

4.3 Excavation and Dewatering

Excavations for the termination stations will generally encounter forest duff, topsoil, soils with roots, silty sand with gravel and cobbles, glacial till with varying amounts of gravel and cobbles and boulders, and shallow bedrock in some areas. Care must be exercised during construction to reduce potential for disturbance of subgrades. Construction traffic on wet soil subgrades should be avoided when practical. Should subgrades become disturbed, the subgrade should be over-excavated to expose suitable soil and replaced with compacted Structural Fill, Gravel Borrow, Crushed Stone or moisture conditioned glacial till.

Based on the proposed grading and subsurface findings at the boring locations, bedrock removal to achieve the required subgrade elevations should be anticipated, particularly in the cut areas of the West Forks station. Bedrock removal will require drilling and blasting. We recommend a licensed blasting contractor be engaged for bedrock removal. Vibrations due to blasting should be monitored during construction. In addition, we recommend the blasting subcontractor submit a detailed drilling and blasting plan with qualifications and references prior to blasting.

Temporary, unsupported soil excavations should be sloped back to 1.5H:1V or flatter. In all cases, excavations must be properly shored and/or sloped according to OSHA regulations to prevent sloughing and caving of the sidewalls during construction.

Sumping and pumping and the use of temporary diversion ditching dewatering techniques should be adequate to control water inflow into excavations above the groundwater table. When working at the bottom of slopes, temporary dewatering may require construction of uphill cut-off swales and/or diversion berms to direct up gradient runoff water away from the work areas.

4.4 Embankment Construction

The proposed topographic information shown on the site grading plan indicates fill and cut soil slopes for the station yards and access roads will be constructed with slopes of

2H:1V or flatter. All forest duff, topsoil, soils with roots and stumps will need to be removed from beneath the proposed yard areas, access roads and fill embankments.

4.4.1 General

Fill slopes should be constructed as level benches, which are overbuilt to facilitate compaction. The final slope face should be constructed by cutting back into the compacted core prior to placing slope surface materials. Fill slopes constructed on existing terrain steeper than 3H:1V should be keyed into the existing ground surface with continuous level benches. Fill slopes constructed on existing slopes flatter than 3H:1V do not need continuous benching. We recommend a 10 foot wide bench be cut into the native soil beneath the toe of fill slopes for installation of a 1-foot thick drainage blanket consisting of Gravel Borrow prior to placing fill soils. The drainage blanket should be day-lighted for gravity drainage.

4.4.2 Fill Slopes 2H:1V or Flatter

Fill materials needed to construct fill slopes at inclinations of 2H:1V or flatter should consist of compacted Common Borrow, Gravel Borrow or Structural Fill. Exposed soil slopes will be susceptible to surface erosion, slumping and sloughing, particularly during heavy rain and freeze/thaw events. Exposed slopes should be surfaced with an erosion control blanket and loam and seed, as soon as practicable, to create a vegetated mat. In areas of concentrated surface water, we recommend 8-inch minus rip-rap overlying a non-woven geotextile fabric such as Mirafi 160N be used in lieu of the erosion blanket and loam and seed. We recommend cross-slope stone lined drainage channels underlain with geotextile fabric be construct into the slope face when the height of the embankment exceeds 25 feet.

4.4.3 Fill Slopes Steeper than 2H:1V

Although not anticipated, if proposed fill slopes are to be constructed steeper than 2H:1V, we recommend these slopes be constructed with compacted Gravel Borrow and the slopes be covered with at least 2 feet of compacted rip-rap. Further, lateral edges where the riprap terminates along the face of the embankment should be keyed into the ground surface. We recommend slopes be constructed no steeper than 1.5H:1V.

4.4.4 Cut Slopes

We recommend proposed soil cut slopes less than 15 feet in height consider slope inclinations of 2H:1V or flatter since the depth to bedrock is unknown between and outside the exploration locations. The final slope inclination will be dependent on the subsurface conditions (soil or bedrock) encountered during construction. Cut slopes in bedrock should be sloped back to a stable condition, which will depend on rock fracturing, as well as bedrock formation strike and dip in relation to slope orientation. We recommend a representative from S.W.COLE observe the bedrock slopes during construction.

We recommend a rock fall catchment zone be provided at the toe of rock cut slopes following FHWA Publication No. HI-99-007 *Rock Slopes Reference Manual.*

In addition, we recommend a minimum 5-foot wide bench be constructed at the interface of the overburden soil and bedrock to reduce potential erosion that could cause soils, cobbles and boulders to wash down the rock slopes potentially clogging drainage swales and causing blocking hazards.

In areas of concentrated surface water or locations of groundwater seeps, rip-rap should be used in lieu of the erosion blanket and loam/seed. We recommend cross-slope stone lined drainage channels underlain with geotextile fabric be constructed into the slope when the height of the slope exceeds 25 feet.

4.4.5 Slope Surface Erosion Control

Unprotected and un-established slopes, regardless of inclination, will be susceptible to surface erosion, slumping, and sloughing especially during precipitations and freeze/thaw events. Topsoil and seed should be installed, as soon as practicable, to create a vegetated mat over the entire surface of the slope. We recommend the use of UV resistant synthetic erosion control mesh to reinforce the surface soils until the vegetated mat is established, particularly if constructed during the winter or spring seasons.

Groundwater seepage and up gradient runoff water can make establishment of soil slopes difficult. In areas where surface water may be concentrated and discharged over the slope or where groundwater seepage is encountered, we recommend locally covering the slope with a small diameter rip-rap placed over a layer of crushed gravel and a woven filter fabric.

4.5 Foundations

4.5.1 Building and Equipment Foundations

We recommend the proposed building foundations be supported on spread footings founded on at least 12-inches of compacted Structural Fill overlying properly prepared subgrades. Unheated building slabs should be underlain with at least 12 inches of compacted Structural fill overlying at least 5 feet of additional Structural Fill or Gravel Borrow. Non-moment-carrying equipment foundations and lightweight equipment pads should also be founded on at least 12-inches of compacted Structural Fill overlying at least 5 feet of compacted Structural Fill or Gravel Borrow. For foundations bearing on properly prepared subgrades, we recommend the following geotechnical parameters for design consideration:

GEOTECHNICAL PARAMETERS	
Net Allowable Soil Bearing Pressure	4.0 ksf or less
Net Allowable Bedrock Bearing Pressure	12.0 ksf (Clean, sound, intact bedrock)
Design Frost Depth for Footings on Soil	6.0 ft
Recommended Minimum Depth for Footings Pinned to Sound, Intact Bedrock	2.5 ft
Base Friction Factor	0.35 (Mass concrete to structural fill)
Base Friction Factor	0.45 (Mass concrete to bedrock)
Passive Lateral Earth Pressure Coeff. (K_p)	3.0 (compacted Structural Fill)
Equivalent Fluid Pressure (Passive)	390 psf/ft (compacted Structural Fill)
Active Lateral Earth Pressure Coeff. (K_a)	0.3 (compacted Structural Fill)
Equivalent Fluid Pressure (Active)	40 psf/ft (compacted Structural Fill)
At-Rest Lateral Earth Pressure Coeff. (K_o)	0.5 (compacted Structural Fill)
Equivalent Fluid Pressure (At-Rest)	60 psf/ft (compacted Structural Fill)
Total Unit Weight of Backfill (γ_t)	125 pcf (compacted Structural Fill)
Internal Friction Angle (Φ)	32 degrees (compacted Structural Fill)

Spread footings should be at least 24 inches in width regardless of the bearing pressure. We understand all foundations and concrete structures and slabs will be designed by others.

4.5.2 Rock Anchors

Based on the subsurface conditions and guidance from the Post-Tensioning Institute's manual entitled *Recommendations for Prestressed Rock and Soil Anchors* (PTI, 2014), we recommend the use of prestressed, Class I corrosion protected, grouted rock anchors be considered by the foundation designer where rock anchors are being considered. We recommend the following geotechnical parameters for preliminary rock anchor design consideration:

GEOTECHNICAL PARAMETERS FOR ROCK ANCHORS	
RQD of Sound Rock Core (see boring logs)	0 to 75 %
Average Dry Unit Weight of Bedrock Samples	169 pcf
Rock Cone Pull-Out Angle (from vertical)	45 degrees (from vertical)
Average Ultimate Grout to Bedrock Bond Strength	120 psi

Note: the above values do not include saprollite (decomposed rock) as found at borings BH-1 and BH-5. Saprolite should be treated as dense soil.

Based on guidance from the *Recommendations for Prestressed Rock and Soil Anchors* (PTI, 2004) we recommend a minimum unbonded length (free-stressing length) of 15 feet for strand tendons and 10 feet for bar tendons be considered for preliminary rock anchor design. The bonded length in sound bedrock will depend upon the uplift load and the diameter of the drill hole. Rock anchor spacing should be at least 1.2 times the free-stressing length; closer spacing will reduce allowable anchor loads. Rock anchors installed in groups should be designed with consideration of pullout resistance from overlapping failure surfaces extending from the midpoint of the anchor bond zone to the bedrock surface.

The drill-hole for each rock anchor should be cleaned of any drilling fines and tightness tested to determine the need for pre-grouting. Rock anchors should be installed, tested and locked-off according to the design engineer's recommendations.

4.5.3 Dead End Structure Foundations

We anticipate dead end structures will be constructed within the proposed station yards. Structural loads and locations are not known at this time. Based on the findings at the explorations, depths to apparent sound bedrock are about 11 and 24 feet below the existing ground surface at borings BH-1 and BH-5, respectively.

Depending upon anticipated structural loads, we anticipate dead end foundations may need to derive support from the underlying bedrock. Depending upon the location and actual subsurface conditions, the foundation could consist of a mat foundation bearing on and anchored to bedrock, or if rock is deep, drilled shafts extending through the pad fills and glacial till and socketed into bedrock. L-pile parameters for use in drilled shaft design are shown on the logs for borings BH-1 and BH-5. Large mat foundation bearing on Structural Fill and properly prepared subgrades are also feasible, depending upon loading conditions. An allowable bearing contact pressure of 12.0 ksf or less should be considered for sound, intact bedrock and 4 ksf or less for compacted Structural Fill. Soft, weathered bedrock, if encountered, should be removed. Where bedrock is encountered, a concrete leveling mat may be placed on the prepared bedrock surface prior to placing reinforced concrete foundations. The leveling mat should extend beyond the footing edges or piers by at least 24 inches. Foundations should be pinned to the bedrock if the rock is sloping steeper than 3H:1V and/or if structural loads dictate. Rock anchors extending into bedrock may be needed to provide uplift capacity for dead end structures founded on mat foundations bearing on bedrock. We understand the dead end structure(s) foundation type and design will be by the project structural engineer.

4.6 Foundation Drainage

We recommend an underdrain system be installed on the outside edge of the perimeter footings for the control buildings. The underdrain pipe should consist of 4-inch diameter, perforated SDR-35 foundation drain pipe bedded in Crushed Stone and covered with non-woven geotextile fabric. The underdrain pipe must have a positive gravity outlet protected from freezing, clogging and backflow. Surface grades should be sloped away from the building and other structures for positive surface water drainage.

4.7 Slab-On-Grade

On-grade floor slabs may be designed using a subgrade reaction modulus of 100 pci (pounds per cubic inch) provided the slab is underlain by at least 12-inches of compacted Structural Fill placed over properly prepared subgrades. The structural engineer or concrete consultant must design steel reinforcing and joint spacing appropriate to slab thickness and function.

We recommend a sub-slab vapor retarder particularly in areas of the building where the concrete slab will be covered with an impermeable surface treatment or floor covering that may be sensitive to moisture vapors, if applicable. The vapor retarder must have a permeance that is less than the floor cover or surface treatment that is applied to the slab. The vapor retarder must have sufficient durability to withstand direct contact with the sub-slab base material and construction activity. The vapor retarder material should be placed according to the manufacturer's recommended method, including the taping and lapping of all joints and wall connections. The architect and/or flooring consultant should select the vapor retarder products compatible with flooring and adhesive materials.

The floor slab should be appropriately cured using moisture retention methods after casting. Typical floor slab curing methods should be used for at least 7 days. The architect or flooring consultant should assign curing methods consistent with current applicable American Concrete Institute (ACI) procedures with consideration of curing method compatibility to proposed surface treatments, flooring and adhesive materials.

4.8 Backfill and Compaction

Although a wide range of soil materials can be used successfully, it has been our experience that granular soils with good drainage characteristics provide significant advantages, particularly in wet conditions and during cold weather construction. We have made recommendations for materials that are suitable for support of the proposed construction from a geotechnical standpoint. However, the electrical designer must provide parameters for fill to achieve proper compatibility between the fill soils and the electrical grounding system. In general, we recommend the following materials for consideration:

Common Borrow: Embankment fill to raise grades in station pad areas below frost depth. We anticipate the native glacial till can be used as Common Borrow provided boulders are removed and at a moisture content at the time of use that will facilitate the required compaction.

Gravel Borrow: Fill to raise grades in the station pad areas should be sand or silty sand meeting the requirements of 2014 MaineDOT Standard Specification 703.20 Gravel Borrow. Gravel Borrow can likely be made from on-site crushing of blasted bedrock.

Structural Fill: Fill to raise grades in the station pad areas and as backfill below footings, equipment pads, adjacent to foundations and material below floor slabs should be clean, non-frost susceptible sand and gravel meeting the gradation requirements for Structural Fill as given below:

Structural Fill	
Sieve Size	**Percent Finer by Weight**
4 inch	100
3 inch	90 to 100
¼ inch	25 to 90
#40	0 to 30
#200	0 to 6

Structural Fill can likely be made from on-site crushing of blasted bedrock.

Crushed Stone: Crushed Stone, used for underdrain aggregate should be washed ¾-inch crushed stone meeting the requirements of 2014 MaineDOT Standard Specification 703.22 Underdrain Backfill Material Type C.

Reuse of Site Soils: The non-organic on-site glacial till appears suitable as Common Borrow and to blend and process with crushed blasted bedrock to create Gravel Borrow, provided they are at a compactable moisture content at the time of blending and reuse. The glacial till borrow, if used for subgrade fill, should be screened of rock over 12 inches.

Placement and Compaction: Fill should be placed in horizontal lifts and compacted such that the desired density is achieved throughout the lift thickness with 3 to 5 passes of the compaction equipment. Loose lift thicknesses for grading, fill and backfill activities should not exceed 12 inches. We recommend that fill and backfill in building areas be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557. Crushed Stone should be compacted with 3 to 5 passes of a vibratory plate compactor having a static weight of at least 500 pounds.

4.9 Weather Considerations

Construction activity should be limited during wet and freezing weather and the site soils may require drying or thawing before construction activities may continue. The contractor should anticipate the need for water to temper fills in order to facilitate compaction during dry weather. If construction takes place during cold weather, subgrades, foundations and floor slabs must be protected during freezing conditions. Concrete and fill must not be placed on frozen soil; and once placed, the concrete and soil beneath the structure must be protected from freezing.

4.10 Design Review and Construction Testing

S.W.COLE should be retained to review the construction documents prior to bidding to determine that our earthwork and foundation recommendations have been properly interpreted and implemented.

A soils and concrete testing program should be implemented during construction to observe compliance with the design concepts, plans, and specifications. S.W.COLE is available to observe earthwork activities, the preparation of foundation bearing surfaces and installation of rock anchors and caiisons, as well as to provide testing and IBC Special Inspection services for soils, concrete, steel and structural masonry construction materials.

4.11 Recommendations for Additional Study

We understand design of the terminal station pads, building and equipment is still in development. We understand additional explorations, laboratory soils and rock testing and evaluation may be needed as design of the terminal stations progresses.

5.0 CLOSURE

It has been a pleasure to be of assistance to you with this phase of your project. We look forward to working with you during the design and construction phase of the project.

Sincerely,

S. W. Cole Engineering, Inc.

STATE OF MAINE
PAUL F.
KOHLER
No. 7145
LICENSED
PROFESSIONAL ENGINEER

Paul F. Kohler, P.E.
Senior Geotechnical Engineer

PFK:nas/tjb/ajh

APPENDIX A

Limitations

This report has been prepared for the exclusive use of Central Maine Power Company for specific application to the proposed Terminal Stations in West Forks Plantation and Moxie Gore, Maine. S. W. Cole Engineering, Inc. (S.W.COLE) has endeavored to conduct our services in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

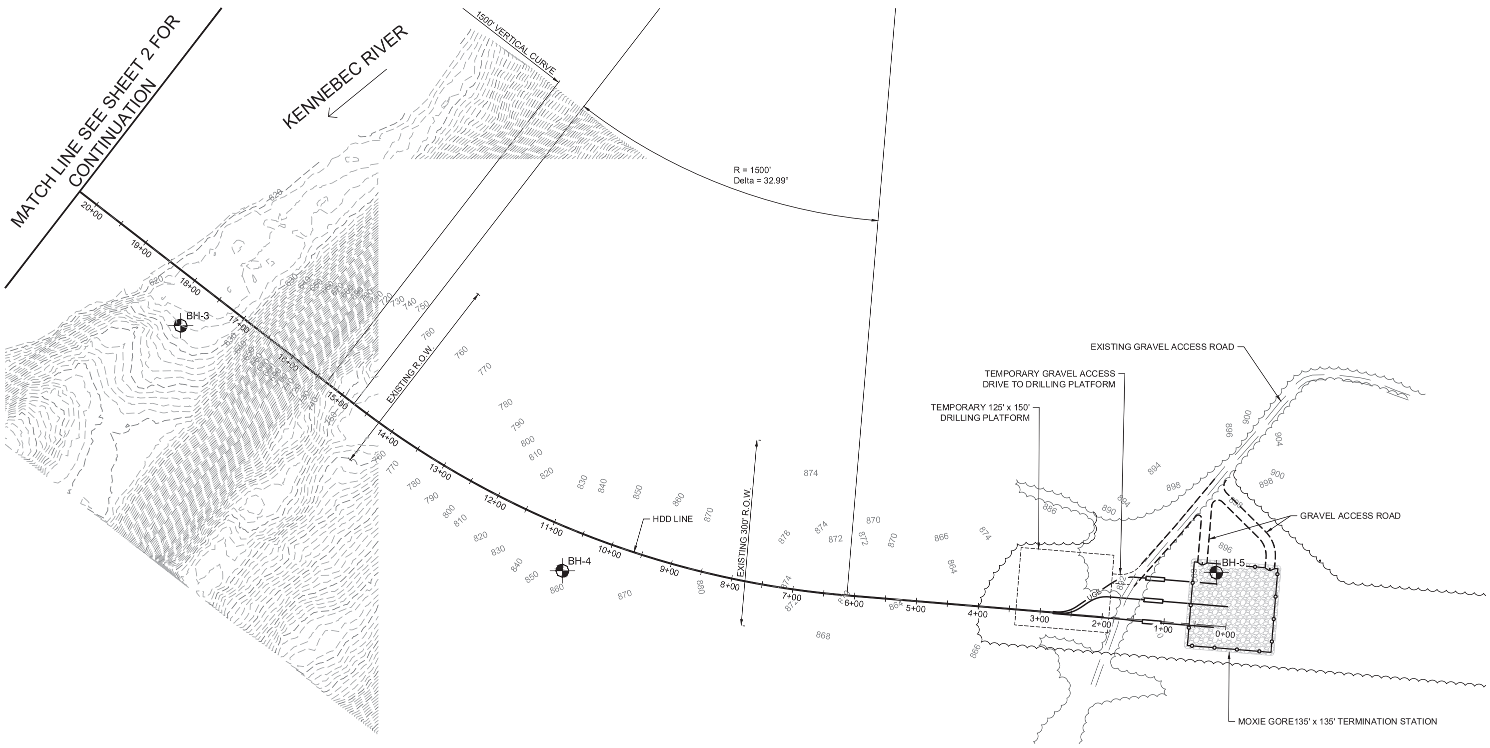
Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

S.W.COLE's scope of services has not included the investigation, detection, or prevention of any Biological Pollutants at the project site or in any existing or proposed structure at the site. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and the byproducts of any such biological organisms.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S.W.COLE should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S.W.COLE.

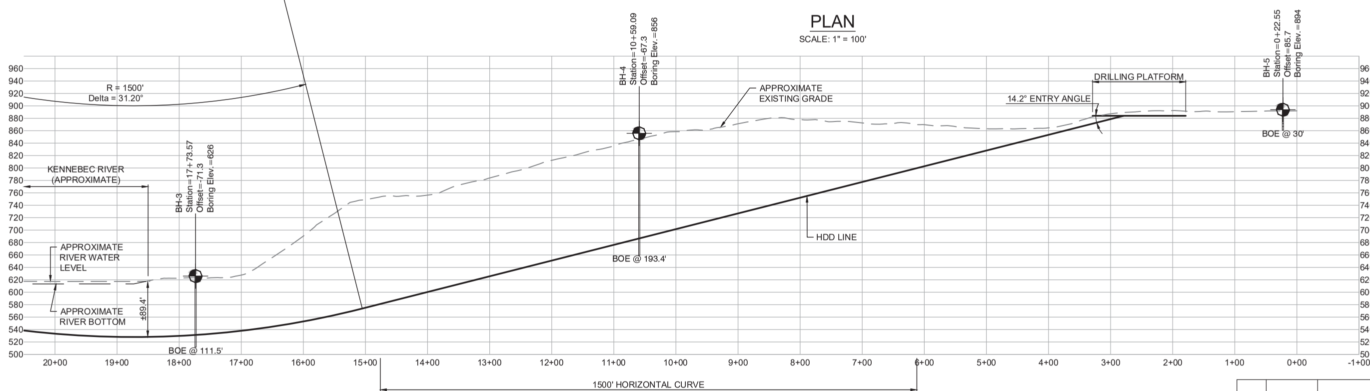
APPENDIX B

Figures



PLAN

SCALE: 1" = 100'



PROFILE

SCALE: HORZ. 1" = 100'
VERT. 1" = 100'

100 0 100 200 FT
SCALE: 1" = 100'

LEGEND:

APPROXIMATE BORING LOCATION

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A 1"=100' SCALE PLAN OF THE SITE ENTITLED "HDD CROSSING (STA 0+00 TO 20+50) PLAN AND PROFILE," PREPARED BY TRC COMPANIES, INC. (TRC), DATED 10/05/2018 AND PROVIDED IN AUTOCAD DWG FORMAT.
2. THE BORING LOCATIONS WERE SELECTED BY TRC AND WERE LOCATED IN THE FIELD BY SURVEY BY COMPREHENSIVE LAND TECHNOLOGIES, INC. (CLT). THE LOCATIONS OF BORINGS BH-2 AND BH-4 WERE ADJUSTED IN THE FIELD AT THE TIME OF LAYOUT BY CLT AND CENTRAL MAINE POWER. THE LOCATION OF BH-4 WAS FURTHER ADJUSTED AT THE TIME OF DRILLING BY S.W.COLE.
3. THIS PLAN SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S. W. COLE ENGINEERING, INC. GEOTECHNICAL REPORT.
4. THE PURPOSE OF THIS PLAN IS ONLY TO DEPICT THE LOCATION OF THE EXPLORATIONS IN RELATION TO THE EXISTING CONDITIONS AND PROPOSED CONSTRUCTION AND IS NOT TO BE USED FOR CONSTRUCTION.

NO.	DATE	DESCRIPTION	BY
.	.	.	.
.	.	.	.
0	12/18/2018	REPORT SUBMITTAL	CEM

S.W.COLE ENGINEERING, INC.

CENTRAL MAINE POWER COMPANY

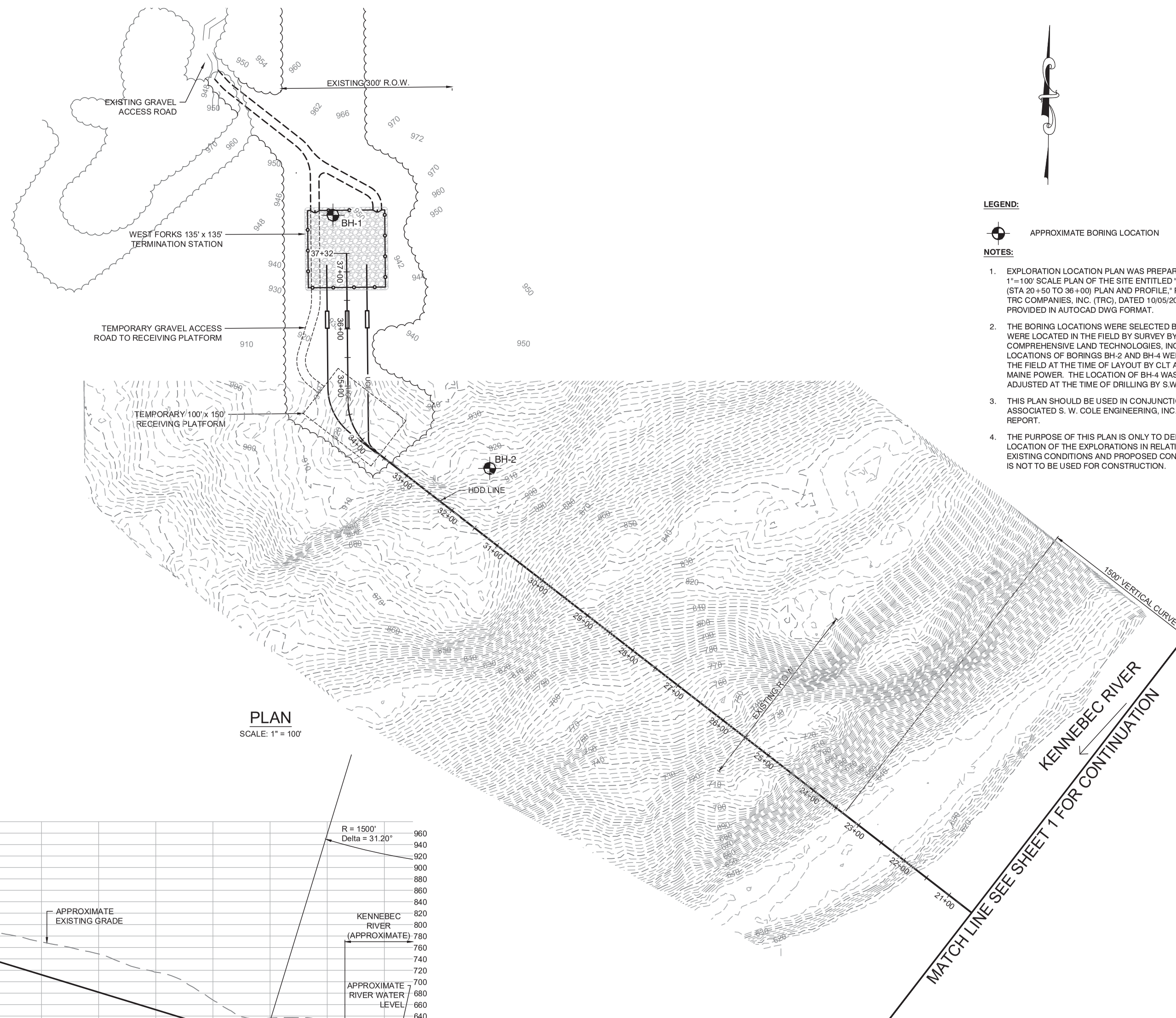
EXPLORATION LOCATION PLAN

PROPOSED KENNEBEC RIVER UNDERGROUND CROSSING
NEW ENGLAND CLEAN ENERGY CONNECT PROJECT
THE FORKS, MAINE

Job No.: 18-0345 Scale: As Noted
Date: 12/18/2018 Sheet: 1 OF 4

Sheet No.: 1

Drawn By: CEM
Checked By: NDS
Approved By: PFK



PLAN
SCALE: 1" = 100'

LEGEND:

APPROXIMATE BORING LOCATION

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A 1"=100' SCALE PLAN OF THE SITE ENTITLED "HDD CROSSING (STA 20+50 TO 36+00) PLAN AND PROFILE," PREPARED BY TRC COMPANIES, INC. (TRC), DATED 10/05/2018 AND PROVIDED IN AUTOCAD DWG FORMAT.
2. THE BORING LOCATIONS WERE SELECTED BY TRC AND WERE LOCATED IN THE FIELD BY SURVEY BY COMPREHENSIVE LAND TECHNOLOGIES, INC. (CLT). THE LOCATIONS OF BORINGS BH-2 AND BH-4 WERE ADJUSTED IN THE FIELD AT THE TIME OF LAYOUT BY CLT AND CENTRAL MAINE POWER. THE LOCATION OF BH-4 WAS FURTHER ADJUSTED AT THE TIME OF DRILLING BY S.W.COLE.
3. THIS PLAN SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S. W. COLE ENGINEERING, INC. GEOTECHNICAL REPORT.
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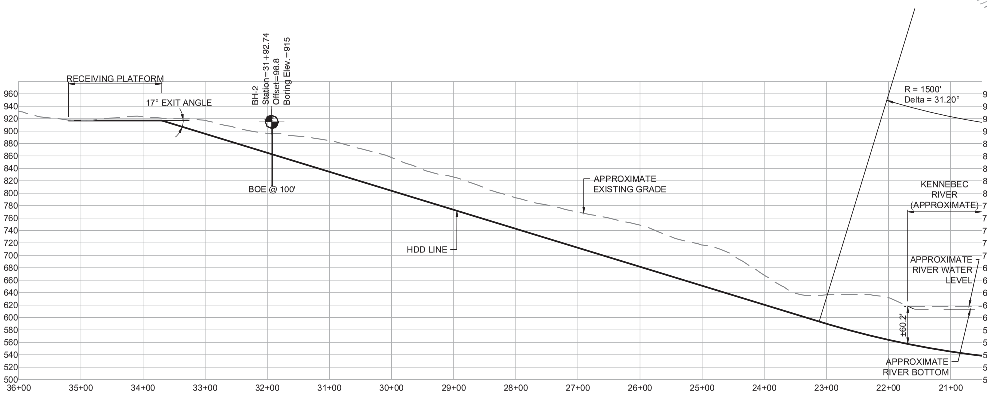


PROFILE
SCALE: HORZ. 1" = 100'
VERT. 1" = 100'

SCALE: 1" = 100'

NO.	DATE	DESCRIPTION	BY
0	12/18/2018	REPORT SUBMITTAL	CEM

S.W.COLE ENGINEERING, INC.

CENTRAL MAINE POWER COMPANY

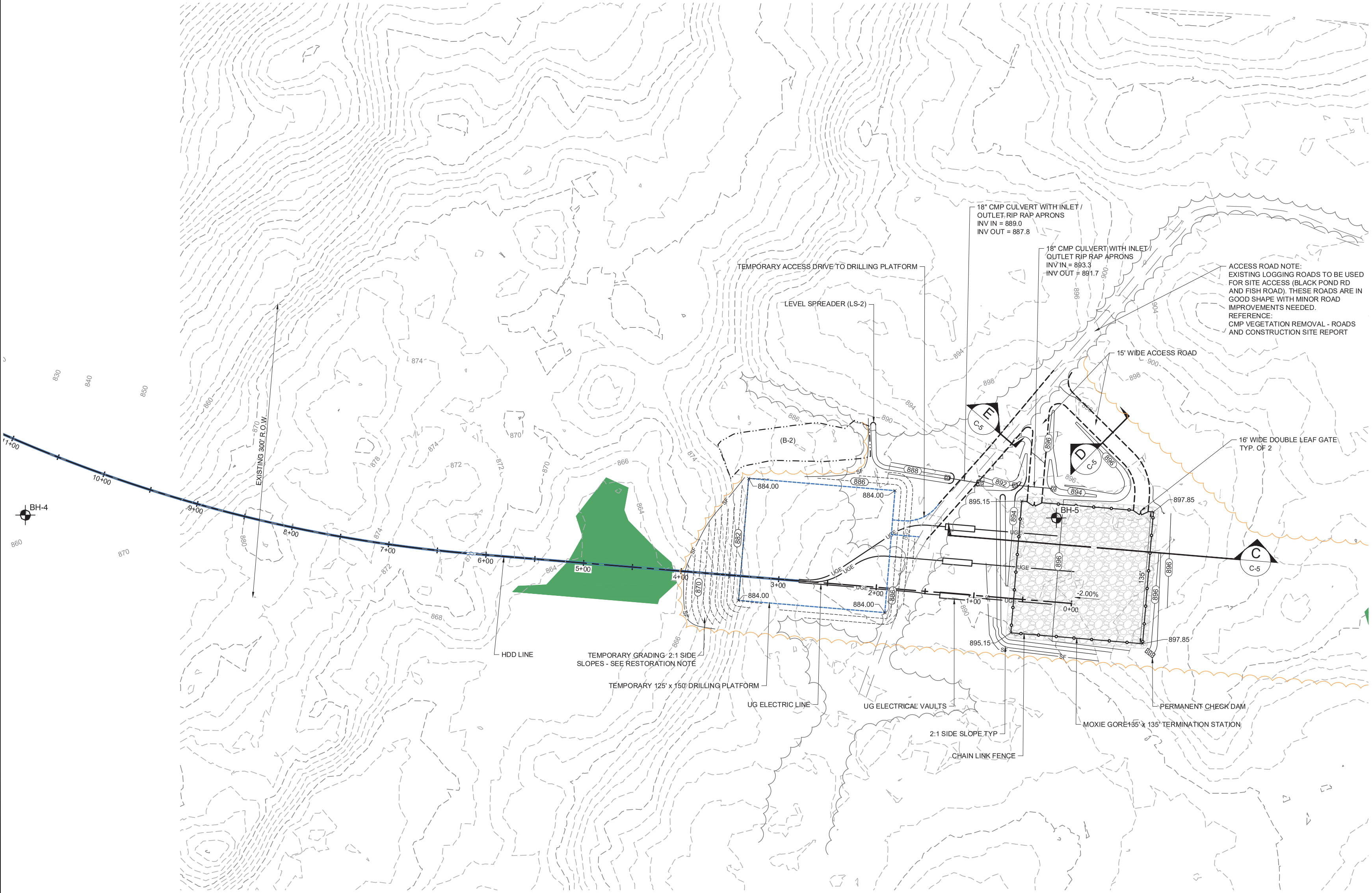
EXPLORATION LOCATION PLAN

PROPOSED KENNEBEC RIVER UNDERGROUND CROSSING
NEW ENGLAND CLEAN ENERGY CONNECT PROJECT
THE FORKS, MAINE

Job No.: 18-0345 Scale: As Noted
Date: 12/18/2018 Sheet: 2 OF 4

Sheet No.: 2

Drawn By: CEM
Checked By: NDS
Approved By: PFK



LEGEND:

APPROXIMATE BORING LOCATION

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A 1"=50' SCALE PLAN OF THE SITE ENTITLED "GRADING & RESTORATION PLAN MOXIE GORE," PREPARED BY TRC COMPANIES, INC. (TRC), DATED 10/05/2018 AND PROVIDED IN AUTOCAD DWG FORMAT.
2. THE BORING LOCATIONS WERE SELECTED BY TRC AND WERE LOCATED IN THE FIELD BY SURVEY BY COMPREHENSIVE LAND TECHNOLOGIES, INC. (CLT). THE LOCATIONS OF BORINGS BH-2 AND BH-4 WERE ADJUSTED IN THE FIELD AT THE TIME OF LAYOUT BY CLT AND CENTRAL MAINE POWER. THE LOCATION OF BH-4 WAS FURTHER ADJUSTED AT THE TIME OF DRILLING BY S.W.COLE.
3. THIS PLAN SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S. W. COLE ENGINEERING, INC. GEOTECHNICAL REPORT.
4. THE PURPOSE OF THIS PLAN IS ONLY TO DEPICT THE LOCATION OF THE EXPLORATIONS IN RELATION TO THE EXISTING CONDITIONS AND PROPOSED CONSTRUCTION AND IS NOT TO BE USED FOR CONSTRUCTION.

50 0 50 100 FT
SCALE: 1" = 50'

NO.	DATE	DESCRIPTION	BY
0	12/18/2018	REPORT SUBMITTAL	CEM

S.W.COLE ENGINEERING, INC.

CENTRAL MAINE POWER COMPANY

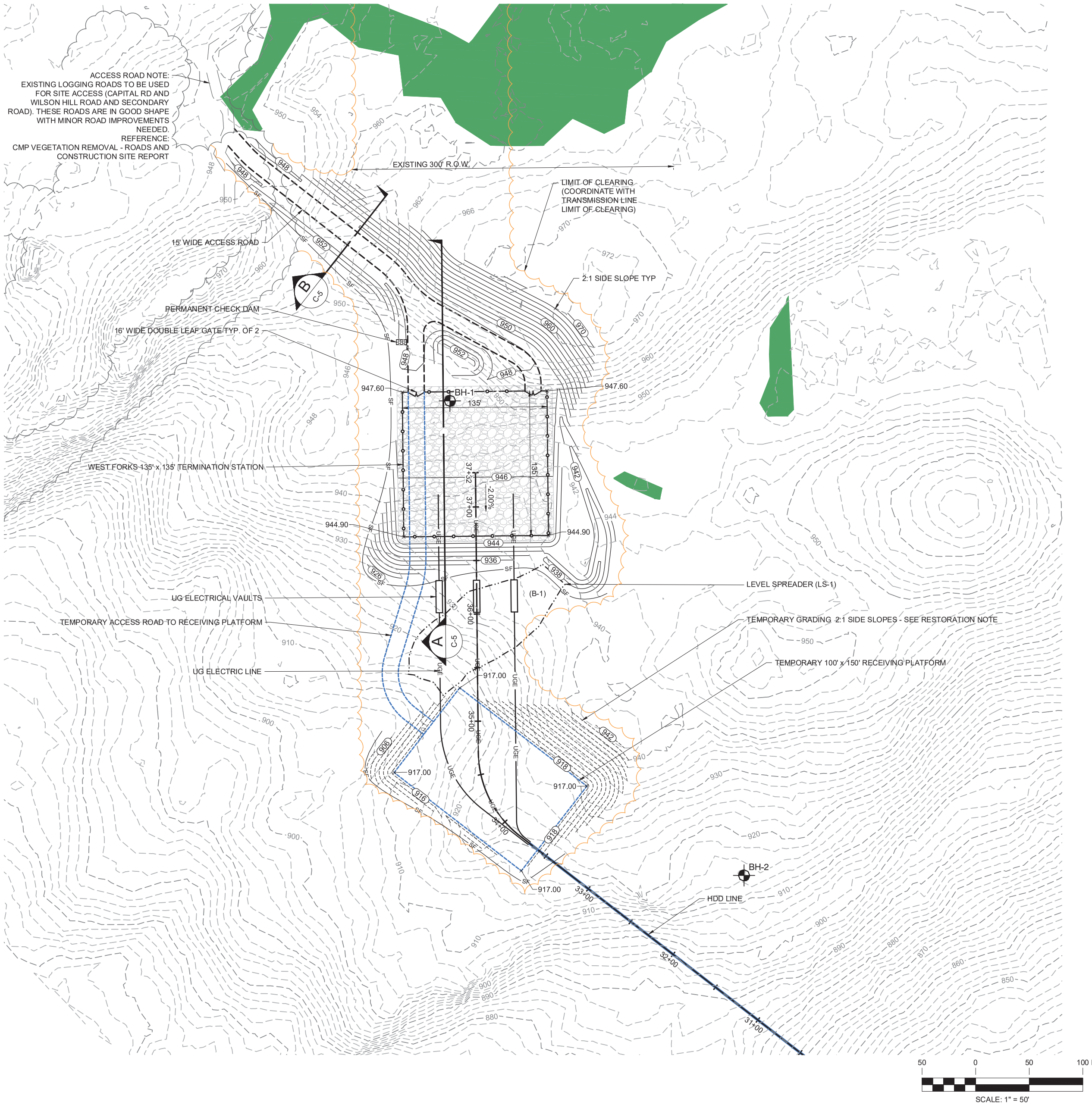
EXPLORATION LOCATION PLAN

PROPOSED KENNEBEC RIVER UNDERGROUND CROSSING
NEW ENGLAND CLEAN ENERGY CONNECT PROJECT
THE FORKS, MAINE

Job No.: 18-0345 Scale: As Noted
Date: 12/18/2018 Sheet: 3 OF 4

Sheet No.: 3

Drawn By: CEM
Checked By: NDS
Approved By: PFK



LEGEND:

APPROXIMATE BORING LOCATION

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A 1"=50' SCALE PLAN OF THE SITE ENTITLED "GRADING & RESTORATION PLAN WEST FORKS," PREPARED BY TRC COMPANIES, INC. (TRC), DATED 10/05/2018 AND PROVIDED IN AUTOCAD DWG FORMAT.
2. THE BORING LOCATIONS WERE SELECTED BY TRC AND WERE LOCATED IN THE FIELD BY SURVEY BY COMPREHENSIVE LAND TECHNOLOGIES, INC. (CLT). THE LOCATIONS OF BORINGS BH-2 AND BH-4 WERE ADJUSTED IN THE FIELD AT THE TIME OF LAYOUT BY CLT AND CENTRAL MAINE POWER. THE LOCATION OF BH-4 WAS FURTHER ADJUSTED AT THE TIME OF DRILLING BY S.W.COLE.
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NO.	DATE	DESCRIPTION	BY
0	12/18/2018	REPORT SUBMITTAL	CEM

S.W.COLE ENGINEERING, INC.

CENTRAL MAINE POWER COMPANY

EXPLORATION LOCATION PLAN

PROPOSED KENNEBEC RIVER UNDERGROUND CROSSING
NEW ENGLAND CLEAN ENERGY CONNECT PROJECT
THE FORKS, MAINE

Job No.: 18-0345 Scale: As Noted
Date: 12/18/2018 Sheet: 4 OF 4

Sheet No.: 4

Drawn By: CEM
Checked By: NDS
Approved By: PFK

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APPENDIX C

Exploration Logs and Key and Rock Core Photos

BORING LOG

BORING NO.:	BH-1
SHEET:	1 of 2
PROJECT NO.	18-0345
DATE START:	10/30/2018
DATE FINISH:	10/30/2018

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 947' Estimated **TOTAL DEPTH (FT):** 30.0 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Kevin Hanscom **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2
HAMMER EFFICIENCY FACTOR: 0.92 **HAMMER DROP (inch):** 30 / 30
WATER LEVEL DEPTHS (ft): 7.6 ft 10/31/2018 Free water at 7.6'
GENERAL NOTES: Following completion of the boring, 3 inch PVC casing installed from 3 feet above existing grade to top of bedrock

KEY TO NOTES AND SYMBOLS:
Water Level: At time of Drilling; At Completion of Drilling; After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_U = Unconfined Compressive Strength, kips/sq.ft.; Ø = Friction Angle (Estimated); N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks	LPile® Input Parameters (Rec)
			1D		0-2	24/10	2-6-7-6	w =26.9 %		Forest Duff			
									0.5	Medium dense, brown Silty SAND, trace gravel			Sand (Reese) γ =115 pcf ϕ =30 ° k =90 pci
945			2D		2-4	24/24	13-20-25-22	w =7.8 %	2.0	Dense, brown Silty SAND and GRAVEL with occasional cobbles (Glacial Till)			Sand (Reese) γ =125 pcf ϕ =34 ° k =150 pci
	5		3D		5-7	24/20	37-32-32-32	w =5.6 %					
940											▼ (7.6)		Sand (Reese) γ =63 pcf ϕ =34 ° k =110 pci
									9.0	Highly weathered / saprolite (decomposed) Bedrock			Weak Rock (Reese) γ =145 pcf
	10		4D		10-10.3	3/3	50/3"						
			R1		11-12.6	19/19	0		11.0	Bedrock; **R1:** Dark Gray Phyllite; soft; Moderately to highly weathered…severe iron oxide staining on core and fracture surfaces; Tightly folded, thin laminated bedding planes at 65-80 degrees from horizontal; Very intensely fractured, pieces 3" and less			Strong Rock (Vuggy Limestone)
935			R2		12.6-13.5	11/11	0			**R2:** Same rock description and properties as R1 above			
			R3		13.5-16.5	36/36	39			**R3:** Same rock description as R1 above; Moderately weathered; Tightly folded, thin laminated bedding planes at 65-80 degrees from horizontal; Very intensely fractured becoming intensely fractured, fractures in pieces 4" and greater at 50-70 degrees from horizontal			
	15												
930			R4		16.5-18.5	24/24	75			**R4:** Same rock description as R1 above; Moderately weathered; Tightly folded, thin laminated bedding planes at 65-80 degrees from horizontal; Slightly to moderately fractured, fractures in pieces 4" and greater at 30-60 degrees from horizontal			
			R5		18.5-21.8	40/40	40			**R5:** Same rock description as R1 above; Moderately weathered; Tightly folded, thin laminated bedding planes at 65-80 degrees from horizontal; Moderately fractured becoming very intensely fractured, fractures in pieces 4" and greater at 60-80 degrees from horizontal. * Compressive strength sample R5, 19.1'-20.5'			
	20												
925			R6		21.8-24.1	28/28	14			**R6:** Same rock description as R1 above; very soft; Highly weathered; Tightly folded, thin laminated bedding planes at 65-80 degrees from horizontal; Intensely fractured, most pieces 2" and less			
			R7		24.1-27.3	38/37	11			**R7:** Same rock description as R1 above; soft; Moderately to highly weathered; Tightly folded, thin			

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

BORING LOG

CLIENT:	Central Maine Power Company
PROJECT:	Proposed Kennebec River Underground Crossing
LOCATION:	NECEC, The Forks Plantation & Moxie Gore, Maine
BORING NO.:	**BH-1**
SHEET:	2 of 2
PROJECT NO.	18-0345
DATE START:	10/30/2018
DATE FINISH:	10/30/2018

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks	LPile® Input Parameters (Rec)
										laminated bedding planes at 65-80 degrees from horizontal; Intensely fractured becoming moderately fractured, fractures at 35-85 degrees from horizontal			
920			R8		27.3-30	32/20	16			**R8:** Same rock description as R1 above (pyrite crystals abundant 28.0'-28.2'); soft; Moderately to highly weathered; Tightly folded, thin laminated bedding planes at 65-80 degrees from horizontal; Intensely fractured, fractures at 25-85 degrees from horizontal			
	30												

Bottom of Exploration at 30.0 feet

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: **BH-1**

BORING LOG

BORING NO.:	BH-2
SHEET:	1 of 4
PROJECT NO.	18-0345
DATE START:	10/30/2018
DATE FINISH:	11/2/2018

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 915' Estimated **TOTAL DEPTH (FT):** 100.0 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Kevin Hanscom **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2
HAMMER EFFICIENCY FACTOR: 0.92 **HAMMER DROP (inch):** 30 / 30
WATER LEVEL DEPTHS (ft): 11/2/2018 Free water observed at 14.4' after coring to 45.0'
GENERAL NOTES: No water return below 74'

KEY TO NOTES AND SYMBOLS: Water Level: ∇ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_U = Unconfined Compressive Strength, kips/sq.ft.; Ø = Friction Angle (Estimated); N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D	D	0-2	24/17	10-32-14-10	w =15.4 %	0.4	Forest Duff		
										Medium dense to dense, brown Gravelly Silty SAND with occasional cobbles (Glacial Till)		
			2D	D	2-4	24/20	9-18-20-27	w =6.1 %				
910	5		3D	D	5-5.2	2/2	50/2"					
									8.2	Bedrock (advanced by rollercone to 9.3')		
905	10		R1	R	9.3-14.3	60/58	55		9.3	**R1:** Light Gray Calcareous Siltstone; moderately hard (MOHS = 5); Moderately weathered…iron oxide staining on core and fracture surfaces; Fine-grained texture; Intensely to moderately fractured, fractures at 40-50 and 70 degrees from horizontal		
900	15		R2	R	14.3-18.6	52/52	62			**R2:** Same rock description as R1 above; Moderately weathered…iron oxide staining on core and fracture surfaces (severely weathered 14.9' to 15.4'); Intensely to moderately fractured, fractures at 10, 30-50 and 70 degrees from horizontal		
			R3	R	18.6-20	17/17	100			**R3:** Same rock description as R1 above; Slightly weathered; Moderately fractured, fractures at 40 and 50 degrees from horizontal		
895	20		R4	R	20-25	60/60	100			**R4:** Same rock description as R1 above; Slightly weathered; Moderately fractured, fractures at 40-55 degrees from horizontal. * Thermal properties sample R4, 22.4'-23.3'		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
			R5		25-30	60/60	100			**R5:** Light Gray Calcareous Siltstone; moderately hard (MOHS = 5); Moderately weathered…iron oxide staining on core and fracture surfaces; Fine-grained texture; Slightly fractured (1 mechanical drilling break), fractures at 50 degrees and 80 degrees from horizontal		
885	30		R6		30-35	60/60	100			**R6:** Same rock description as R5 above; Slightly fractured (some mechanical drilling breaks), fractures at 35-55 degrees from horizontal		
880	35		R7		35-40	60/60	100			**R7:** Same rock description as R5 above; Slightly weathered; Slightly fractured (mechanical drilling breaks), fractures at 40-50 degrees from horizontal. * Compressive strength sample R9, 46.1' -47.4'		
875	40		R8		40-45	60/60	100			**R8:** Same rock description as R5 above; Slightly weathered; Slightly fractured (mechanical drilling breaks), fractures at 30-45 degrees from horizontal		
870	45		R9		45-50	60/60	87			**R9:** Light Gray Calcareous Siltstone; moderately hard (MOHS = 5); Slightly to moderately weathered…slight pitting on core surface; Fine grained texture; Moderately fractured, fractures at 10 degrees, 30-65 degrees from horizontal. * Compressive strength sample R11, 54.5' -55.9'		
865	50		R10		50-54.5	54/54	96			**R10:** Same rock description as R9 above; Fractures at 5 degrees, 30-40 degrees, and 65 degrees from horizontal		
860	55		R11		54.5-59.5	60/60	85			**R11:** Same rock description as R9 above; Moderately to intensely fractured, fractures at 5-10 degrees, 30-55 degrees from horizontal		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

BORING LOG

BORING NO.:	BH-2
SHEET:	3 of 4
PROJECT NO.	18-0345
DATE START:	10/30/2018
DATE FINISH:	11/2/2018

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
855	60		R12		59.5-64.7	62/62	100			**R12:** Same rock description as R9 above; Slightly to moderately fractured, fractures at 20-30 degrees, 30-55 degrees from horizontal		
850	65		R13		64.7-69.9	62/62	100			**R13:** Light Gray Calcareous Siltstone; moderately hard (MOHS = 5); Slightly weathered…slight pitting on core surface and slight staining on some fracture surfaces; Fine grained texture; Slightly fractured, fractures at 15-30 degrees and 70 degrees from horizontal.		
845	70		R14		69.9-73.3	41/36	88			**R14:** Same rock description as R13 above; Slightly to moderately fractured, fractures at 15 degrees and 50-60 degrees from horizontal; * Compressive strength sample R14, 69.9' -70.8'		
			R15		73.3-75.5	26/26	100			**R15:** Same rock description as R13 above; Slightly to moderately fractured, fractures at 5 degrees and 20-30 degrees from horizontal		
840	75		R16		75-80	60/60	100			**R16:** Same rock description as R13 above; Slightly to moderately weathered… moderate pitting on core surface and slight staining on fracture surfaces; Slightly to moderately fractured, fractures at 40-50 degrees and 80 degrees from horizontal		
835	80		R17		80-85	60/60	92			**R17:** Light Gray Calcareous Siltstone; moderately hard (MOHS = 5); Slightly to moderately weathered…slight pitting on core surface and slight staining on some fracture surfaces; Fine grained texture; Slightly to moderately fractured (some mechanical drilling breaks), fractures at 30 degrees and 50-70 degrees from horizontal		
830	85		R18		85-90	60/60	100			**R18:** Same rock description as R17 above; Slightly weathered; Slightly to moderately fractured (mechanical drilling breaks), fractures at 30-40 degrees and 60-70 degrees from horizontal		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

BORING NO.: BH-2
SHEET: 4 of 4
PROJECT NO. 18-0345
DATE START: 10/30/2018
DATE FINISH: 11/2/2018

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
825	90		R19		90-94.2	50/50	88			**R19:** Same rock description as R17 above; Slightly to moderately fractured (some mechanical drilling breaks), fractures at 40-50 degrees from horizontal		
			R20		94.2-95	10/10	100			**R20:** Same rock description as R17 above; Slightly weathered; Unfractured		
820	95		R21		95-96.5	18/18	100			**R21:** Same rock description as R17 above; Slightly to moderately fractured (some mechanical drilling breaks), fractures at 55-60 degrees from horizontal		
			R22		96.5-100	42/42	100			**R22:** Same rock description as R17 above; Moderately weathered; Slightly to moderately fractured (some mechanical drilling breaks), fractures at 40-65 degrees from horizontal		
815	100											

Bottom of Exploration at 100.0 feet

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING LOG

BORING NO.:	BH-3
SHEET:	1 of 4
PROJECT NO.	18-0345
DATE START:	11/26/2018
DATE FINISH:	11/28/2018

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 626' Estimated **TOTAL DEPTH (FT):** 111.5 **LOGGED BY:** Paul Kohler
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Kevin Hanscom **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2
HAMMER EFFICIENCY FACTOR: 0.92 **HAMMER DROP (inch):** 30 / 30
WATER LEVEL DEPTHS (ft): ▼ 4 ft 11/28/2018 Free water at 4'
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling

D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear

Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot

WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector

S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
Ø = Friction Angle (Estimated)
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
			1D		0-2	24/12	5-5-17-11			Forest Duff (0.4)		
625										Medium dense to dense, brown Gravelly Silty SAND with occasional cobbles (Glacial Till)		
											▼	
	5		2D		5-5.3	4/4	50/4"					
620												
			R-1		8.4-10.3	23/23	0			8.4 Bedrock; **R1:** Gray Slate; soft to moderately soft (MOHS = 3-4); Highly weathered…iron oxide staining on core and fracture surfaces; Faint, thin laminated bedding planes at 75-85 degrees from horizontal; Intensely, most fractures parallel to bedding planes		
	10		R-2		10.3-14.5	50/50	51			**R2:** Same rock description as R1 above; moderately soft to moderately hard (MOHS = 4-5); Moderately weathered to highly weathered… iron oxide staining on core and fracture surfaces; Slightly fractured to intensely fractured, fractures at 60-85 degrees from horizontal		
615												
	15		R-3		14.5-15.4	11/10	0			**R3:** Same rock description as R1 above; moderately soft (MOHS = 4); Highly weathered…iron oxide staining on core and fracture surfaces; Intensely fractured; fractures mostly parallel to bedding planes at 85 degrees from horizontal		
610			R-4		15.4-19	43/43				**R4:** Gray Slate; moderately soft to moderately hard (MOHS = 4-5); Highly weathered; iron oxide staining on core and fracture surfaces; Moderately to intensely fractured, fractures at 30, 50 and 80 degrees from horizontal		
	20		R-5		19-22.6	43/35	37			**R5:** Same rock description as R1 above; moderately hard (MOHS = 5); Moderately to highly weathered… iron oxide staining on core and fracture surfaces; Moderately to intensely fractured, fractures at 5 and 75-85 degrees from horizontal		
605												
			R-6		22.6-25.9	39/39				**R6:** Same rock description as R1 above; moderately soft to moderately hard (MOHS = 4-5); Highly weathered… iron oxide staining on core and fracture surfaces; Intensely fractured (some mechanical drilling breaks), fractures at 75-95 degrees from horizontal		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

BORING LOG

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

PROJECT NO. 18-0345
DATE START: 11/26/2018
DATE FINISH: 11/28/2018

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
600			R-7		25.8-29.6	45/45	85			**R7:** Gray Slate with thin (0.5" or less) Quartz seams; moderately hard to hard (MOHS = 5-6); Slightly to moderately weathered…iron oxide staining on some fracture surfaces; Faint, thin laminated bedding planes at 75-85 degrees from horizontal; Slightly fractured (mechanical drilling breaks), fractures at 45 and 75 degrees from horizontal		
	30		R-8		29.5-34.5	60/47	43			**R8:** Same rock description as R7 above; Slightly weathered; Slightly fractured (mechanical drilling breaks), fractures at 25 and 75-85 degrees		
595												
	35		R-9		34.5-39.5	60/60	41			**R9:** Gray Slate with zones of Phylitte; moderately hard (MOHS = 5); Slightly weathered; Slightly to moderately fractured (some mechanical drilling breaks), fractures at 10-30 and 80-90 degrees from horizontal		
590												
	40		R-10		39.5-44.5	60/60	81			**R10:** Gray Slate; moderately hard (MOHS = 5); Fresh to slightly weathered; Faint, thin laminated bedding planes at 70-80 degrees from horizontal; Slightly to moderately fractured (some mechanical drilling breaks), fractures at 20 and 70 degrees from horizontal		
585												
	45		R-11		44.5-49.5	60/60	98			**R11:** Gray Slate; moderately hard to hard (MOHS = 5-6); Fresh to slightly weathered; Very faint, thin laminated bedding planes at 80-85 degrees from horizontal; Very slightly fractured (mechanical drilling breaks), fractures at 5-10 and 20-25 degrees from horizontal		
580												
	50		R-12		49.5-54.5	60/60	68			**R12:** Gray Slate with thin (0.5" or less) Quartz seams; moderately hard to hard (MOHS = 5-6); Slightly weathered; Slightly to moderately fractured (some mechanical drilling breaks), fractures at 10 and 30-45 degrees from horizontal		
575												
	55		R-13		54.5-59.5	60/60	56			**R13:** Gray Slate with thin (0.25" or less) Quartz seams; moderately hard to hard (MOHS = 5-6); Slightly to moderately weathered (slight iron oxide staining on some fracture surfaces; Slightly to moderately fractured (some mechanical drilling breaks), fractures at 5-10, 40 and 85 degrees from horizontal		
570												

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(Continued Next Page)

BORING LOG

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

BORING NO.: BH-3

PROJECT NO. 18-0345
DATE START: 11/26/2018
DATE FINISH: 11/28/2018

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
	60		R-14		59.5-61.1	19/18	26			**R14:** Gray Slate; moderately hard (MOHS = 5); Slightly weathered; Moderately fractured (mechanical drilling breaks), fractures at 45 and 85 degrees from horizontal		
565			R15		61.1-64.5	41/40	97			**R15:** Same rock description as R14 above; Fresh to slightly weathered; Very slightly fractured (mechanical drilling breaks), fractures at 5 degrees from horizontal		
	65		R16		64.5-67.7	38/37	94			**R16:** Gray Slate transitioning to Phyllite; moderately hard (MOHS = 5); Slightly weathered; Thin, slightly folded, laminated bedding planes at 75-80 degrees from horizontal; Very slightly fractured (mechanical drilling break), fracture at 10 degrees from horizontal		
560												
			R17		67.7-71.5	46/46	100			**R17:** Gray Phyllite; moderately hard (MOHS = 5); Slightly weathered; Very slightly fractured (mechanical drilling breaks), fracture at 75 degrees from horizontal		
	70											
555												
			R18		71.5-76.5	60/60	60			**R18:** Gray Phyllite transitioning to Slate; moderately hard (MOHS = 5); Fresh to slightly weathered; Moderately fractured (some mechanical drilling breaks), fractures at 30-40 and 60-70 degrees from horizontal		
	75											
550												
			R-19		76.5-81.5	60/60	95			**R19:** Gray Slate; moderately hard (MOHS = 5); A few Pyrite crystals on core surface; Fresh to slightly weathered; Slightly to moderately fractured (mechanical drilling breaks), fractures at 30 and 70-75 degrees from horizontal. * Compressive strength sample 79.2'-81.0'		
	80											
545												
			R20		81.5-86.5	60/60	100			**R20:** Gray Slate; moderately hard (MOHS = 5); Fresh to slightly weathered; Very faint, thin laminated bedding planes at 70-80 degrees from horizontal; Slightly to moderately fractured (mechanical drilling breaks), fractures at 5, 40 and 70 degrees from horizontal. * Compressive strength sample: 90.3' - 91.2'		
	85											
540												
			R-21		86.5-91.5	60/60	70			**R21:** Gray Slate with thin (0.5" or less) Quartz seams; moderately hard to hard (MOHS = 5-6); Fresh to slightly weathered; Moderately fractured (some mechanical drilling breaks), fractures at 35 and 75 degrees from horizontal		

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BORING LOG

BORING NO.:	BH-3
SHEET:	4 of 4
PROJECT NO.	18-0345
DATE START:	11/26/2018
DATE FINISH:	11/28/2018

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
	90											
535												
			R-22 R-23		91.5-92.1 92.1-96.5	7/7 53/53	0 81			**R22:** Gray Slate; moderately hard (MOHS = 5); Slightly weathered; Highly fractured (some mechanical drilling breaks), fractures at 35 and 85 degrees from horizontal **R23:** Gray Slate; moderately hard (MOHS = 5); Slightly weathered; Slightly to moderately fractured (some mechanical drilling breaks), fractures at 50 and 70-80 degrees from horizontal		
	95											
530												
			R-24		96.5-101.5	60/60	70			**R24:** Gray Slate; moderately hard (MOHS = 5); Fresh to slightly weathered; Slightly to moderately fractured (some mechanical drilling breaks), fractures at 10 and 40-80 degrees from horizontal. * Compressive strength sample: 100.0' - 101.1'		
	100											
525												
			R-25		101.5-106.5	60/60	56			**R25:** Gray Slate with Quartz inclusions; moderately hard to hard (MOHS = 5-6); Slightly weathered; Very faint, thin laminated bedding planes at 75-80 degrees from horizontal; Moderately fractured (some mechanical drilling breaks), fractures at 50 and 65-70 degrees from horizontal		
	105											
520												
			R-26		106.5-111.5	60/32	56			**R26:** Gray Slate with Quartz inclusions; moderately hard to hard (MOHS = 5-6); Fresh to slightly weathered; Slightly fractured (some mechanical drilling breaks), fractures at 65 and 80 degrees from horizontal. * Compressive strength sample: 110.0'-111.3'		
	110											
515												

Bottom of Exploration at 111.5 feet

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BORING NO.: **BH-3**

BORING LOG

BORING NO.: BH-4
SHEET: 1 of 7
CLIENT: Central Maine Power Company
PROJECT NO. 18-0345
PROJECT: Proposed Kennebec River Underground Crossing
DATE START: 11/5/2018
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine
DATE FINISH: 11/9/2018

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 856' Estimated **TOTAL DEPTH (FT):** 193.4 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Kevin Hanscom **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2
HAMMER EFFICIENCY FACTOR: 0.92 **HAMMER DROP (inch):** 30 / 30
WATER LEVEL DEPTHS (ft): ▼ 21.8 ft Free water at 21.8' on 11/9/18 after coring to 193.4' on 11/8/18
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level
∇ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling
D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear
Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot
WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
Ø = Friction Angle (Estimated)
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
			1D		0-1.5	18/10	2-2-19-25/0/0"			Forest Duff		
855								w =15.3 %	1.0	Medium dense, reddish-brown Silty SAND, some gravel with numerous cobbles		
			2D		2-3.3	16/14	9-25-50/4"	w =20.1 %				
	5								4.0	Bedrock (advanced by rollercone to 6')		
850			R1		6-9.6	43/39	91		6.0	**R1:** Gray Slate with very thin (1/8" or less) Quartz zones; moderately hard (MOHS = 5); Moderately weathered….some slight pitting and iron oxide staining on core surface; Very thin laminated bedding planes at 55 to 65 degrees from horizontal; Moderately tight fractures varying between 10 degrees and 85 degrees from horizontal * Thermal Properties Sample R1, 6.9'-8.4'		
	10		R2		9.6-11	17/5	0			**R2:** Gray Slate with very thin (1/8" or less) Quartz zones; Moderately hard (MOHS = 5); Moderately weathered….some slight pitting and iron oxide staining on core surface; Very thin laminated bedding planes at 55 to 65 degrees from horizontal; Moderately tight fractures varying between 10 degrees and 85 degrees from horizontal		
845			R3		11-11.4	5/5	0			**R3:** Gray Slate; Soft (crumbled by hand pressure); highly weathered and very intensely fractured; Bedding planes and fracture orientation difficult to discern due to degree of fracturing		
			R4		11.4-14.6	38/38	61			**R4:** Gray to rusty gray Slate with Quartz zones ¼" to 1" in thickness; Soft becoming hard (MOHS = 4-6); Highly weathered becoming moderately weathered….pitting up to ¼" deep on core surface; Intensely fractured becoming moderately fractured; Faint thin bedding planes at 50 to 65 degrees from horizontal; Fractures at 5 degrees to 60 degrees from horizontal		
	15		R5		14.6-17.8	38/38	63			**R5:** Gray Slate with very thin (1/8" or less) Quartz zones; moderately hard (MOHS = 5); Moderately weathered becoming slightly weathered….some slight pitting and iron oxide staining on core surface; Thin laminated bedding planes at 60 degrees to 70 degrees from horizontal; Slightly to moderately fractured with fracture angles mostly parallel to bedding planes * Thermal Properties Sample R5, 14.6'-16.5'		
840												
			R6		17.8-19.6	22/22	73			**R6:** Gray Slate; Moderately hard (MOHS = 5); Slightly weathered; Thin laminated bedding planes at 60 degrees to 75 degrees from horizontal; Slightly to moderately fractured with fracture angles mostly parallel to bedding planes * Thermal Properties Sample R6, 17.8'-19.3'		
	20		R7		19.6-21.6	24/24	25			**R7:** Gray Slate; Moderately hard (MOHS = 5); Moderately weathered…slight iron oxide staining on fracture surfaces; Thin laminated bedding planes at 65 degrees to 75 degrees from horizontal; Moderately to intensely fractured with most fracture angles parallel to bedding planes		
835			R8		21.6-24.6	36/35	67			**R8:** Gray Slate; hard (MOHS = 5-6); Moderately weathered; Faint, thin laminated bedding planes at 70-80 degrees from horizontal; Moderately to intensely fractured, fractures at 5, 35 and 80 degrees from horizontal	▼	

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CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine
PROJECT NO. 18-0345
DATE START: 11/5/2018
DATE FINISH: 11/9/2018

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
830			R9		24.6-28.8	50/49	92			**R9:** Same rock description as R8 above; Slightly weathered; Fractures at 5, 35-40 and 70 degrees from horizontal		
825	30		R10		28.8-31.5	32/32	50			**R10:** Same rock description as R8 above; moderately hard (MOHS = 5); Slightly to moderately weathered (iron oxide staining on fracture surfaces); Fractures at 20, 45, and 70-80 degrees from horizontal		
			R11		31.5-34.7	38/38	0			**R11:** Same rock description as R8 above (MOHS = 5); Moderately weathered; Intensely fractured, fractures at 45-50 and 85-90 degrees from horizontal		
820	35		R12		34.7-38.7	48/48	29			**R12:** Same rock description as R8 above (MOHS = 5); Moderately weathered (some iron oxide staining on fracture surfaces); Moderately to intensely fractured, fractures at 65-85 degrees from horizontal		
815	40		R13		38.7-41.6	35/35	100			**R13:** Gray Slate; hard (MOHS = 5-6); Slightly to moderately weathered; Faint, thin laminated bedding planes at 75-80 degrees from horizontal; Slightly to moderately fractured, fractures at 35-45 degrees from horizontal		
			R14		41.6-45.1	42/42	100			**R14:** Same rock description as R13 above; Slightly weathered; Very slightly fractured, the one fracture at 30 degrees from horizontal		
810	45		R15		45.1-49.6	54/54	100			**R15:** Same rock description as R13 above; Slightly weathered; Very slightly fractured, the one fracture (mechanical drilling break) at 25 degrees from horizontal		
805	50		R16		49.6-54.6	60/60	90			**R16:** Same rock description as R13 above; Slightly weathered; Slightly fractured, fractures (some mechanical breaks) at 20 and 70 degrees from horizontal		
800	55		R17		54.6-59.6	60/60	82			**R17:** Same rock description as R13 above; Fresh to slightly weathered; Slightly fractured, fractures (some mechanical breaks) at 15-20 and 70-75 degrees from horizontal		

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BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

BORING NO.: BH-4
SHEET: 3 of 7
PROJECT NO. 18-0345
DATE START: 11/5/2018
DATE FINISH: 11/9/2018

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
795	60		R18		59.6-64.6	60/60	100			**R18:** Gray Slate; moderately hard (MOHS = 5); Moderately weathered…iron oxide staining on fracture surfaces; Fine grained texture; Faint, very thin laminated bedding planes at 80-85 degrees from horizontal; Slightly fractured, fractures at 0, 30 and 65-85 degrees from horizontal		
790	65		R19		64.6-69.6	60/60	50			**R19:** Gray Slate becoming Calcareous Slate-some Pyrite crystals on core and fracture surfaces; Slightly to moderately fractured, fractures at 5, 25 and 85-90 degrees from horizontal		
785	70		R20		69.6-74.6	60/57	75			**R20:** Same rock description as R18 above (no Pyrite); Slightly weathered; Slightly to moderately fractured, fractures at 25-40 and 85 degrees from horizontal		
780	75		R21		74.6-79.6	60/60	100			**R21:** Gray Calcareous Slate transitioning to Calcareous Siltstone; moderately hard (MOHS =5); Slightly weathered; Very fine grained texture; Slightly fractured, fractures at 25, 45, and 85 degrees from horizontal		
775	80		R22		79.6-84.6	60/60	93			**R22:** Gray Calcareous Siltstone; moderately hard (MOHS = 5); Slightly weathered; Very fine grained texture; Slightly fractured, fractures at 5 and 20-25 degrees from horizontal		
770	85		R23		84.6-89.6	60/60	100			**R23:** Same rock description as R22 above; Slightly fractured (mechanical drilling breaks), fractures at 5-10 and 55 degrees from horizontal		

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BORING LOG

BORING NO.:	BH-4
SHEET:	4 of 7
PROJECT NO.	18-0345
DATE START:	11/5/2018
DATE FINISH:	11/9/2018

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
765	90		R24		89.6-94.6	60/60	100			**R24:** Same rock description as R22 above; Slightly fractured (mechanical drilling breaks), fractures at 5 and 50 degrees from horizontal		
760	95		R25		94.6-99.6	60/60	100			**R25:** Same rock description as R22 above; Slightly fractured (mechanical drilling breaks), fractures at 15, 50 and 75 degrees from horizontal		
755	100		R26		99.6-102.5	35/35	100			**R26:** Gray Calcareous Siltstone; moderately hard to hard (MOHS = 5-6); Slightly weathered; Fine grained texture; Unfractured		
			R27		102.5-104.6	25/25	100			**R27:** Same rock description as R26 above; Slightly weathered; Slightly fractured (some mechanical drilling breaks), fractures at 70-85 degrees from horizontal		
750	105		R28		104.6-108.9	52/51	92			**R28:** Same rock description as R26 above; Slightly weathered; Slightly fractured (some mechanical drilling breaks), fractures at 5, 25 and 70 degrees from horizontal		
745	110		R29		108.9-114	61/61	100			**R29:** Same rock description as R26 above; Moderately weathered…iron oxide staining on some fracture surfaces; Slightly fractured (some mechanical drilling breaks); fractures at 60 and 75-85 degrees from horizontal		
740	115		R30		114-117.5	42/42	0			**R30:** Gray Calcareous Siltstone transitioning to Calcareous Slate (Siltstone moderately hard, Slate soft); Moderately (Siltstone) to highly (Slate) weathered, Moderately (Siltstone) to intensely (Slate) fractured; Siltstone fine grained texture; Slate has very faint laminated bedding planes at 85 degrees from horizontal; most fractures parallel to Slate bedding planes		
			R31		117.5-119	18/18	0			**R31:** Gray Calcareous Slate; soft and highly weathered; Intensely fractured with most fractures parallel to 85 degree bedding planes		
735	120		R32		119-124.2	62/62	47			**R32:** Gray Calcareous Slate; moderately hard (MOHS = 5); Moderately weathered; Very faint thin laminated bedding planes at 80-85 degrees from horizontal; Slightly to intensely fractured, fractures at 5, 20-40 and 65-85 degrees from horizontal		

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BORING LOG

BORING NO.:	**BH-4**
SHEET:	5 of 7
PROJECT NO.	18-0345
DATE START:	11/5/2018
DATE FINISH:	11/9/2018

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
730	125		R33		124.2-129.4	62/62	100			**R33:** Gray Calcareous Slate (Phyllite zone 128.5'-129.4'); Moderately hard (MOHS = 5); Slightly to moderately weathered; Very faint thin laminated bedding planes at 80-85 degrees from horizontal; Slightly to moderately fractured (mechanical drilling breaks), fractures at 10, 50 and 80 degrees from horizontal		
725	130		R34		129.4-134.6	62/62	100			**R34:** Same rock description as R32 above; Slightly to moderately fractured (mechanical drilling breaks), fractures at 5-10 and 55 degrees from horizontal		
720	135		R35		134.6-139.6	60/60	57			**R35:** Same rock description as R32 above; Slightly fractured (mechanical drilling breaks), fractures at 35, 65 -70, and 85-90 degrees from horizontal		
715	140		R36		139.6-144.6	60/60	97			**R36:** Gray Calcareous Slate; moderately hard (MOHS = 5); Slightly weathered; Very faint thin laminated bedding planes at 75-85 degrees from horizontal; Moderately fractured (some mechanical drilling breaks), fractures at 40 and 65-85 degrees from horizontal		
710	145		R37		144.6-149.6	60/60	83			**R37:** Same rock description as R36 above; Moderately hard (MOHS = 5); Slightly weathered to fresh; Moderately fractured (some mechanical drilling breaks), fractures at 35-45 and 75-85 degrees from horizontal * Compressive strength sample: 146.8' - 148.5'		
705	150		R38		149.6-154.6	60/60	93			**R38:** Gray calcareous Slate transitioning to calcareous Siltstone; Moderately hard (MOHS = 5); Siltstone has fine-grained texture; Moderately fractured (some mechanical drilling breaks), fractures at 15-35, 45, and 85 degrees from horizontal		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

BORING NO.: BH-4
SHEET: 6 of 7
PROJECT NO. 18-0345
DATE START: 11/5/2018
DATE FINISH: 11/9/2018

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_2O Depth	Remarks
	155		R39		154.6-158.5	47/47	83			**R39:** Gray calcareous Siltstone transitioning to calcareous slate; moderately hard (MOHS = 5); Slightly weathered to fresh; Slate has very faint, thin laminated bedding planes at 70-80 degrees from horizontal; Slightly fractured (mechanical drilling breaks), fractures at 5, 35-45, and 70 degrees from horizontal		
700												
			R40		158.5-161.6	37/37	100			**R40:** Gray calcareous Slate transitioning to calcareous phyllite; moderately hard (MOHS = 5); Slightly weathered; Very faint thin laminated bedding planes at 70-80 degrees from horizontal; Slightly fractured (mechanical drilling breaks), fractures at 75 degrees from horizontal		
	160											
695												
			R41		161.6-166.6	60/60	98			**R41:** Same rock description as R40 above; Slightly to moderately fractured (some mechanical drilling breaks); fractures at 30-50 degrees from horizontal		
	165											
690												
			R42		166.6-171.6	60/60	72			**R42:** Same rock description as R40 above; Slightly weathered to fresh; Slightly fractured (some mechanical drilling breaks); fractures at 5-10 and 35 degrees from horizontal		
	170											
685												
			R43		171.6-176.6	60/60	100			**R43:** Same rock description as R40 above; Slightly fractured (mechanical drilling breaks); fractures at 25-35 and 75 degrees from horizontal * Compressive strength sample: 174.9' - 175.7'		
	175											
680												
			R44		176.6-181.6	60/60	78			**R44:** Gray calcareous Phyllite with quartz inclusions; moderately hard to hard (MOHS = 5-6); Fresh to slightly weathered; Very faint thin laminated bedding planes at 80-85 degrees from horizontal; Slightly to moderately fractured, fractures at 5 and 80-85 degrees from horizontal		
	180											
675												
			R45		181.6-186.6	60/60	63			**R45:** Same rock description as R44 above; Moderately fractured; fractures at 10-20 and 85 degrees from horizontal		
	185											
670												

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

BORING LOG

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

BORING NO.: BH-4
SHEET: 7 of 7
PROJECT NO. 18-0345
DATE START: 11/5/2018
DATE FINISH: 11/9/2018

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
			R46		186.6-191.6	60/60	93			**R46:** Gray calcareous Phyllite; moderately hard (MOHS = 5); Slightly weathered; Very faint thin laminated bedding planes at 75-85 degrees from horizontal; Slightly to moderately fractured (some mechanical drilling breaks); fractures at 5-10 and 80 degrees from horizontal		
	190											
665												
			R47		191.6-193.4	22/22	100			**R47:** Same rock description as R46 above; Slightly to moderately fractured (mechanical drilling breaks); Fractures at 5-10 degrees from horizontal		

Bottom of Exploration at 193.4 feet

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: BH-4

BORING LOG

BORING NO.:	BH-5
SHEET:	1 of 2
PROJECT NO.	18-0345
DATE START:	11/2/2018
DATE FINISH:	11/5/2018

S.W.COLE ENGINEERING, INC.

CLIENT: Central Maine Power Company
PROJECT: Proposed Kennebec River Underground Crossing
LOCATION: NECEC, The Forks Plantation & Moxie Gore, Maine

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 894' Estimated **TOTAL DEPTH (FT):** 30.0 **LOGGED BY:** Nate Strout
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Kevin Hanscom **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted Diedrich D-50 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2
HAMMER EFFICIENCY FACTOR: 0.92 **HAMMER DROP (inch):** 30 / 30
WATER LEVEL DEPTHS (ft): ▼ 3.7 ft 11/6/2018 Free water at 3.7' on 11/6/2018
GENERAL NOTES: Following completion of the boring, 3 inch PVC casing installed from 3 feet above existing grade to top of bedrock

KEY TO NOTES AND SYMBOLS:
Water Level
▽ At time of Drilling
▼ At Completion of Drilling
▼ After Drilling

D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear

Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot

WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector

S_v = Field Vane Shear Strength, kips/sq.ft.
q_U = Unconfined Compressive Strength, kips/sq.ft.
Ø = Friction Angle (Estimated)
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks	LPile® Input Parameters (Rec)
			1D	D	0-2	24/9	1-5-7-8	w =16.3 %		Forest Duff			
									0.5	Medium dense, brown Gravelly SILT and SAND (Glacial Till)			Sand (Reese) γ =115 pcf ϕ =30 ° k =90 pci
			2D	D	2-4	24/10	16-24-35-37	w =4.4 %			▼		
890	5												Sand (Reese) γ =58 pcf ϕ =30 ° k =60 pci
			3D	D	5-7	24/17	11-8-6-9	w =10.9 %	5.0	Medium dense, brown SILT and SAND, some gravel with occasional cobbles (Glacial Till)			Sand (Reese) γ =58 pcf ϕ =32 ° k =80 pci
885	10		4D	D	10-12	24/20	13-16-15-26	w =13.2 %					
880	15		5D	D	15-17	24/21	19-22-26-35	w =13.5 %	15.0	Dense, gray Sandy SILT, some gravel, some clay (Glacial Till)			Sand (Reese) γ =63 pcf ϕ =32 ° k =90 pci
875	20								19.5	Saprolite (decomposed) Bedrock			Weak Rock (Reese) γ =145 pcf
			6D	D	21.5-21.8	4/4	50/4"						
870			R1	R	24-27.6	43/26	16		24.0	Bedrock; **R1:** Gray Slate; soft to moderately hard (MOHS = 3-5);			Strong Rock (Vuggy

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

(Continued Next Page)

BORING LOG

CLIENT:	Central Maine Power Company
PROJECT:	Proposed Kennebec River Underground Crossing
LOCATION:	NECEC, The Forks Plantation & Moxie Gore, Maine
BORING NO.:	BH-5
SHEET:	2 of 2
PROJECT NO.	18-0345
DATE START:	11/2/2018
DATE FINISH:	11/5/2018

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks	LPile® Input Parameters (Rec)
										Highly weathered becoming moderately weathered; Very thin laminated bedding planes at 60 degrees from horizontal; Very tight fractures paralleling bedding planes			Limestone)
865	30		R2		27.6-30	29/29	38			**R2:** Gray Slate with thin (1/4" or less) Quartz zones; moderately hard (MOHS = 5); Moderately weathered….iron oxide staining on some fracture surfaces; Very thin laminated bedding planes at 45 to 65 degrees from horizontal; Very tight fractures mostly paralleling bedding planes			

Bottom of Exploration at 30.0 feet

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: BH-5

S.W.COLE ENGINEERING, INC. • Geotechnical Engineering • Field & Lab Testing • Scientific & Environmental Consulting

KEY TO NOTES & SYMBOLS
Test Boring and Test Pit Explorations

All stratification lines represent the approximate boundary between soil types and the transition may be gradual.

Key to Symbols Used:

w	-	water content, percent (dry weight basis)
q_u	-	unconfined compressive strength, kips/sq. ft. - laboratory test
S_v	-	field vane shear strength, kips/sq. ft.
L_v	-	lab vane shear strength, kips/sq. ft.
q_p	-	unconfined compressive strength, kips/sq. ft. – pocket penetrometer test
O	-	organic content, percent (dry weight basis)
W_L	-	liquid limit - Atterberg test
W_P	-	plastic limit - Atterberg test
WOH	-	advance by weight of hammer
WOM	-	advance by weight of man
WOR	-	advance by weight of rods
HYD	-	advance by force of hydraulic piston on drill
RQD	-	Rock Quality Designator - an index of the quality of a rock mass.
γ_T	-	total soil weight
γ_B	-	buoyant soil weight

Description of Proportions:

Trace:	0 to 5%
Some:	5 to 12%
"Y"	12 to 35%
And	35+%
With	Undifferentiated

Description of Stratified Soils

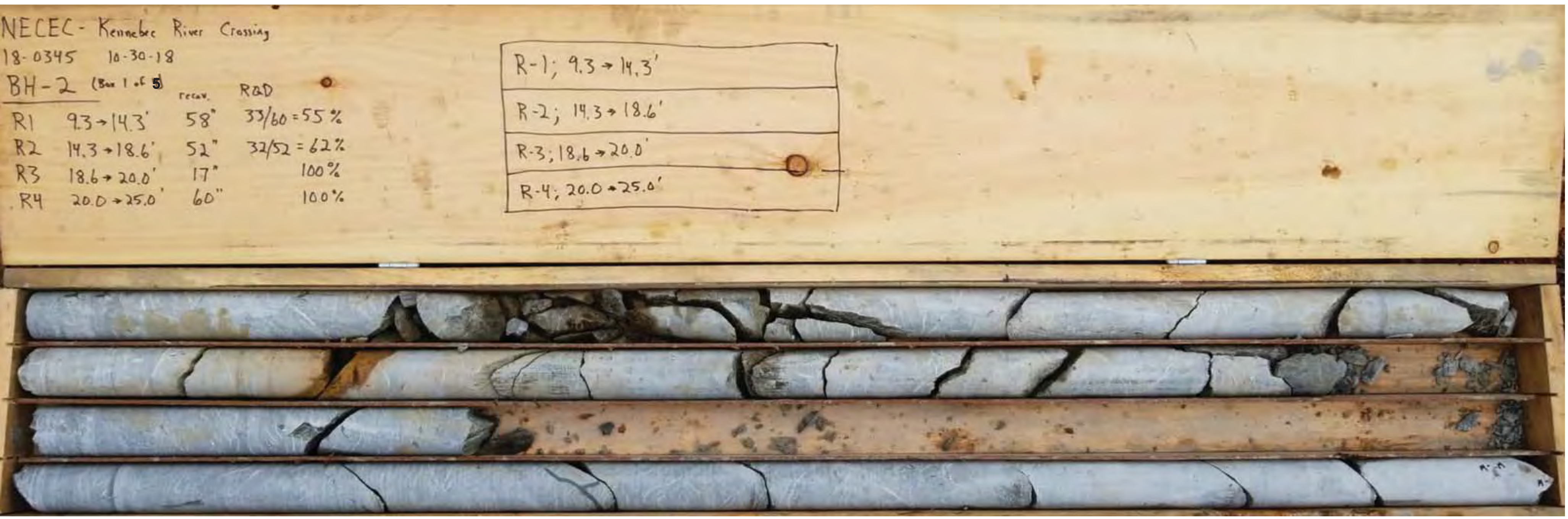
Parting:	0 to 1/16" thickness
Seam:	1/16" to 1/2" thickness
Layer:	½" to 12" thickness
Varved:	Alternating seams or layers
Occasional:	one or less per foot of thickness
Frequent:	more than one per foot of thickness

REFUSAL: **Test Boring Explorations** - Refusal depth indicates that depth at which, in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

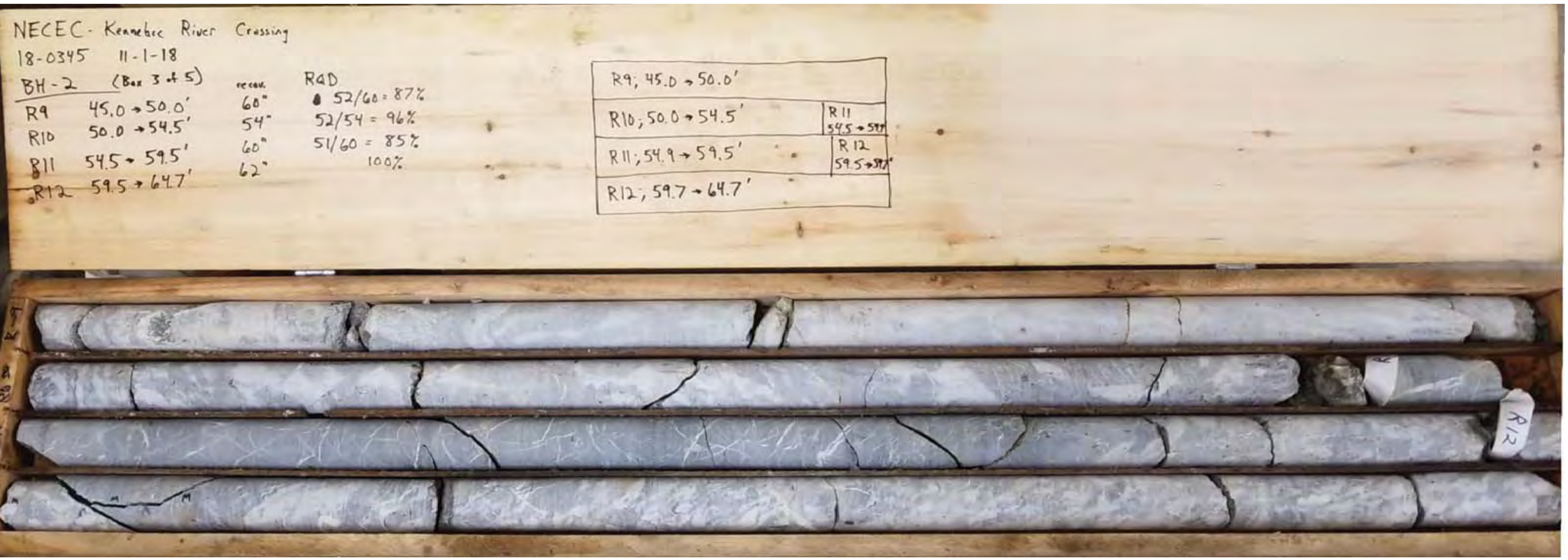
REFUSAL: **Test Pit Explorations** - Refusal depth indicates that depth at which sufficient resistance to the advance of the backhoe bucket was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man-made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.

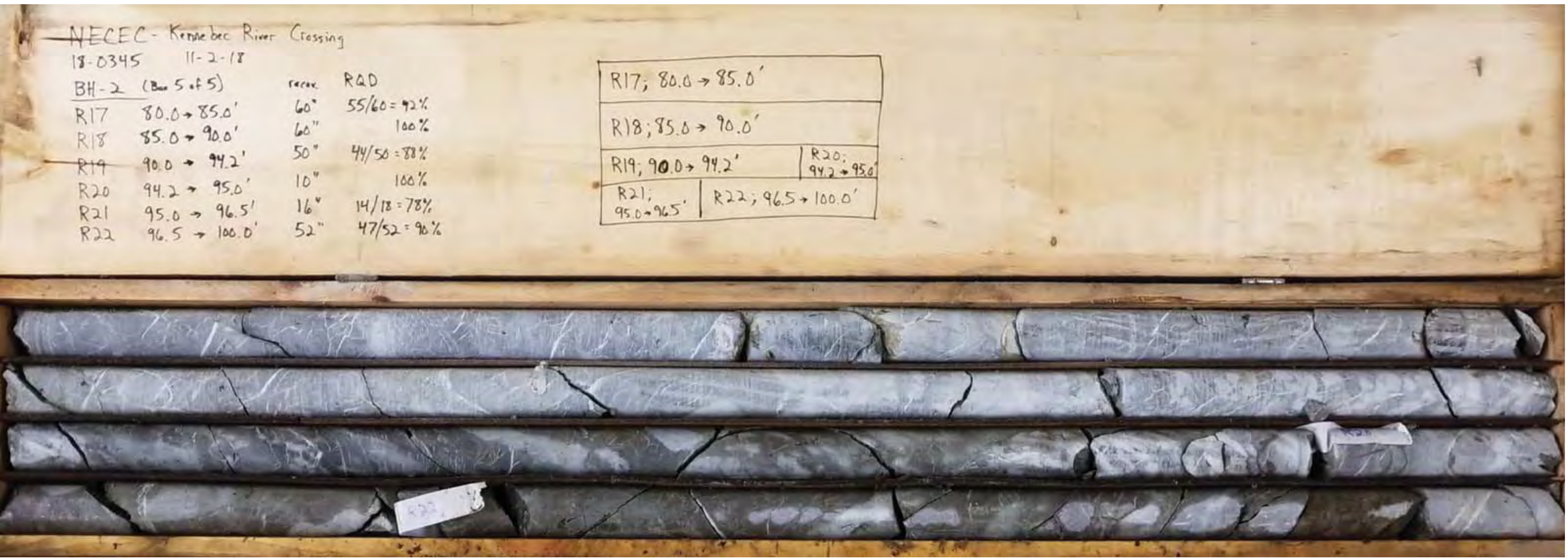
NECEC - Kennebec River Crossing
18-0345 10-30-18
BH-1 recov. RQD
R1 11→12.6' 19" 0
R2 12.6→13.5' 11" 0
R3 13.5→16.5' 36" 14/36=39%
R4 16.5→18.5' 24" 18/24=75%
R5 18.5→21.8' 40" 16/40=40%
R6 21.8→24.1' 28" 4/28=14%
R7 24.1→27.3' 37" 4/38=11%
R8 27.3→30.0' 25" 5/32=16%
R1; 11.0→12.6'
R2; 12.6→13.5'
R3; 13.5→15.8
R3; 15.8→16.5'
R4; 16.5→18.5'
R5; 18.5→20.5'
R5; 20.5→21.8'
R6; 21.8→24.1'
R7; 24.1→25.1'
R7; 25.1→27.3'
R8; 27.3→30.0'


NECEC - Kennebec River Crossing
18-0345 10-30-18
BH-2 (Box 1 of 5)
recov. RQD
R1 9.3 → 14.3' 58" 33/60 = 55%
R2 14.3 → 18.6' 52" 32/52 = 62%
R3 18.6 → 20.0' 17" 100%
R4 20.0 → 25.0' 60" 100%
R-1; 9.3 → 14.3'
R-2; 14.3 → 18.6'
R-3; 18.6 → 20.0'
R-4; 20.0 → 25.0'


NECEC- Kennebec River Crossing
18-0345 10-31-18
BH-2 (Box 2 of 5)
recov. RQD
R5 25.0 → 30.0' 60" 100%
R6 30.0 → 35.0' 60" 100%
R7 35.0 → 40.0' 60 100%
R8 40.0 → 45.0' 60 100%
R5; 25.0 → 30.0'
R6; 30.0 → 35.0'
R7; 35.0 → 40.0'
R8; 40.0 → 45.0'

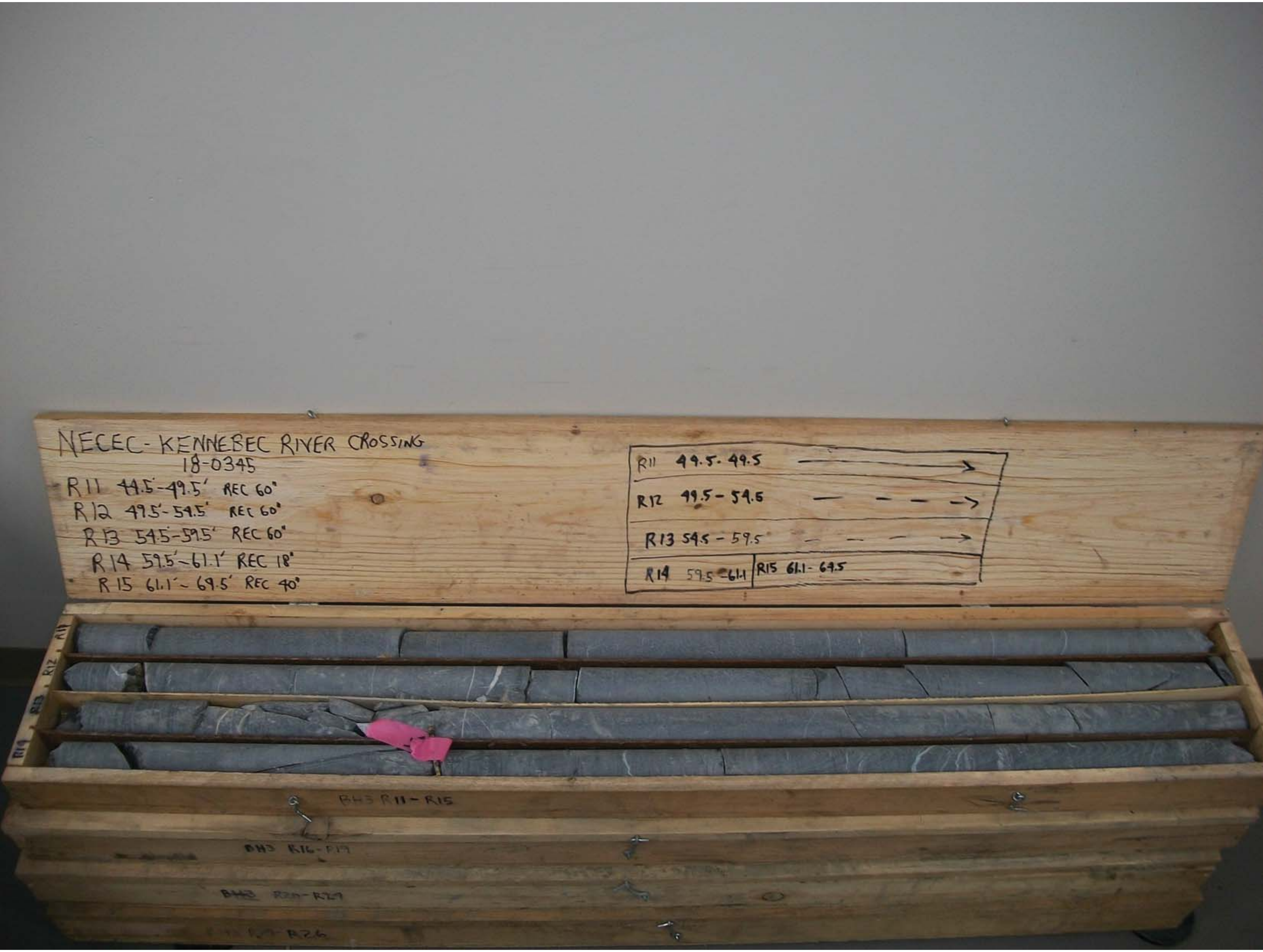

NECEC - Kennebec River Crossing
18-0345 11-1-18
BH-2 (Box 3 of 5)
recov. RQD
R9 45.0 → 50.0' 60" 52/60 = 87%
R10 50.0 → 54.5' 54" 52/54 = 96%
R11 54.5 → 59.5' 60" 51/60 = 85%
R12 59.5 → 64.7' 62" 100%
R9; 45.0 → 50.0'
R10; 50.0 → 54.5'
R11
R11; 54.9 → 59.5'
R12
R12; 59.7 → 64.7'
R12


NECEC - Kennebec River Crossing
18-0345 11-1-18
BH-2 (Box 4 of 5)
recov. RQD
R13 64.7 → 69.9' 62" 100%
R14 69.9 → 73.3' 36" 36/41 =
R15 73.3 → 75.0' 26" 100%
R16 75.0 → 80.0' 60" 100%
R13; 64.7 → 69.5'
R13; 69.5 → 69.9' R14; 69.9 → 73.3' R15 73.3 → 74.1'
R15 74.1 → 75.0' R16; 75.0 → 78.6'
R16; 78.6 → 80.0'
R16


NECEC - Kennebec River Crossing
18-0345 11-2-18
BH-2 (Box 5 of 5) recov. RQD
R17 80.0 → 85.0' 60" 55/60 = 92%
R18 85.0 → 90.0' 60" 100%
R19 90.0 → 94.2' 50" 44/50 = 88%
R20 94.2 → 95.0' 10" 100%
R21 95.0 → 96.5' 16" 14/18 = 78%
R22 96.5 → 100.0' 52" 47/52 = 90%
R17; 80.0 → 85.0'
R18; 85.0 → 90.0'
R19; 90.0 → 94.2'
R20; 94.2 → 95.0'
R21; 95.0 → 96.5'
R22; 96.5 → 100.0'

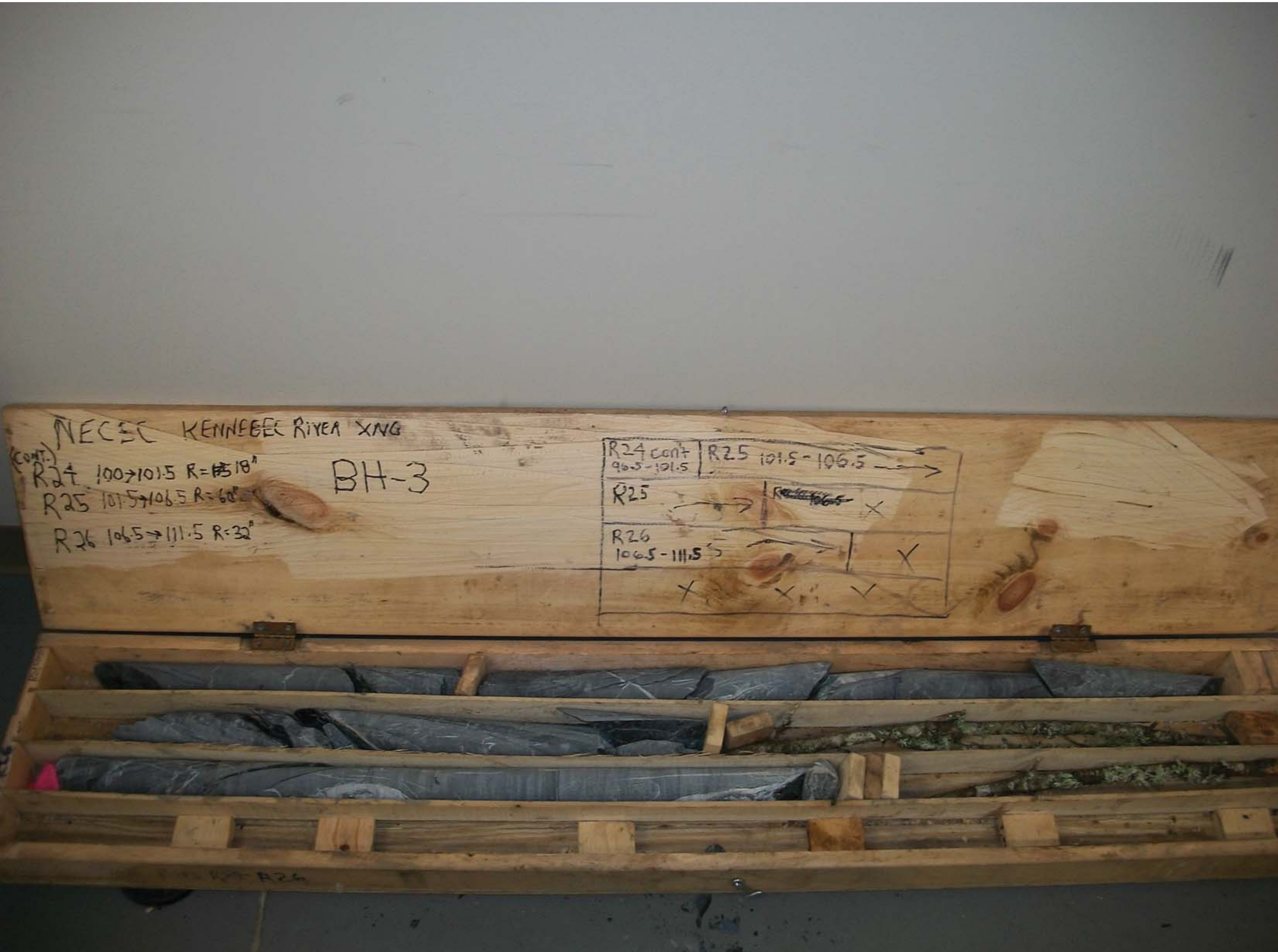

NECEC KRC 18-0345
BH-3
REC RQD
R-1 8.9-10.3 23"/1.9' 0/23=0
R-2 10.3-14.5
R-3 19.5-15.9 10" 0/11=0
R-4 15.4-19 48" 4/43=9
R-5 19-22.6 35" 12/43=30
R-6 22.6-25.9 39" 7/39=18
BH-3 R-1 8.9-10.3
BH-3 R-2 10.3-14.5
R2
BH-3 R3 14.5-15.4
BH-3 R4 15.4-19
R4
R5 19-22.6
R5
R6 26.2-25.8
BH3 R1-R6


NECEC KENNEBEC RIVER CROSSING
18-0345 11-26-2018 BH-3
R7 25.8 → 29.6 REC 45"
R8 29.5 → 34.5 REC 47"
R9 34.5 → 39.5 REC 60"
R10 39.5 → 44.5 REC 60"
R7 25.8 - 29.5
R8 29.5 - 34.5
R8
R9 34.5 - 39.5
R9
R10 39.5 - 44.5
R10
BH3 R7-R10
BH3 R11-R15


NECEC-KENNEBEC RIVER CROSSING
18-0345
R11 44.5'-49.5' REC 60"
R12 49.5'-54.5' REC 60"
R13 54.5'-59.5' REC 60"
R14 59.5'-61.1' REC 18"
R15 61.1'-69.5' REC 40"
R11 44.5-49.5
R12 49.5-54.5
R13 54.5-59.5
R14 59.5-61.1
R15 61.1-69.5
BH3 R11-R15

NECEC - KENNEBEC RIVER CROSSING
18-0345
R16 69.5-67.7 REC 37"
R17 67.7'-71.5' REC 46"
R18 71.5'-76.5' REC 60"
R19 76.5'-81.5' REC 60"
R16 69.5-67.7
R17 67.7-71.5
R18 71.5-76.5
R18
R19 76.5-81.5
R19
BH3 R16-R19

NECEC KENNEBEC RIVER CROSSING
10-0345
R20 81.5 → 86.5 REC = 60"
R21 86.5 → 91.5 REC = 60"
R22 91.5 → 92.1 REC = 7"
R23 92.1 → 96.5 REC = 53"
R24 96.5 → 101.5 REC = 60"
BH-3
R20 81.5 - 86.5
R21 86.5 - 91.5
R22 91.5 - 92.1
R23 92.1 - 96.5
R23
R24 96.5 - 101.5
cont Next Box
BH3 R20-R24



NECEC KENNEBEC RIVER XNG
(CONT.)
R24 100→101.5 R=18"
R25 101.5→106.5 R=60"
R26 106.5→111.5 R=32"
BH-3
R24 cont 96.5-101.5
R25 101.5-106.5
R25
R26 106.5-111.5


NECEC - Kennebec River Crossing
18-0345 11-5-18
BH-5 recov RQD
R1 24.0→27.6' 26" 7/43 = 16%
R2 27.6→30.0' 29" 11/29 = 38%
BH-4 (Box 1 of 10) recov RQD
R1 6.0→9.6' 39" 39/43 = 91%
R2 9.6→11.0' 5" 0
R3 11.0→11.4' 5" 0
R4 11.4→14.6' 38" 23/38 = 61%
BH-5; R1, 24.0→27.6'
BH-5; R2, 27.6→30.0'
BH-4; R1, 6.0→9.6'
BH-4; R2 9.6→11.0'
BH-4; R3 11.0→11.4'
BH-4; R4; 12→14.6'
BH-4; R5, 14.6→17'
BH-4; R5 17→17.8'
BH-4 R6 17.8→19.6'
BH-4; R7, 19.6→21.6'
BH-4 recov RQD
R5 14.6→17.8' 38" 24/38 = 63%
R6 17.8→19.6' 22" 16/22 = 73%
R7 19.6→21.6' 24" 6/24 = 25%
R2
R4
R5
R6
R7


NECEC & Kennebec River Crossing
18-0345 11-6-18
BH-4 (Box 2 of 10) recov. RQD
R8 21.6→24.6' 35" 24/36=67%
R9 24.6→28.8' 49" 46/50=92%
R10 28.8→31.5' 32" 16/32=50%
R11 31.5→34.7' 38" 0
R12 34.7→38.7' 48 14/48
R13 38.7'→41.6' 35" 100%
R8; 21.6→24.6'
R9; 24.6→26.6'
R9; 26.6→28.8'
R10; 28.8→31.5'
R11; 31.5'→34.7'
R12; 34.7→36.1'
R12; 36.1→38.7'
R13; 38.7→40.9'
R9
R10
R13


NECEC - Kennebec River Crossing
18-0345 11-6-18
BH-4 (Box 3 of 10)
recov. RQD (38.7→40.9' in box 2)
R13 38.7→41.6' 35" 100%
R14 41.6→45.1' 42" 100%
R15 45.1→49.6' 54" 100%
R16 49.6→54.6' 60" 54/60=90%
R17 54.6→59.6' 60" 49/60=82%
R13; 40.9→41.6'
R14; 41.6→45.1'
R15; 45.1→49.6'
R16; 49.6→54.6'
R17; 54.6→59.6'

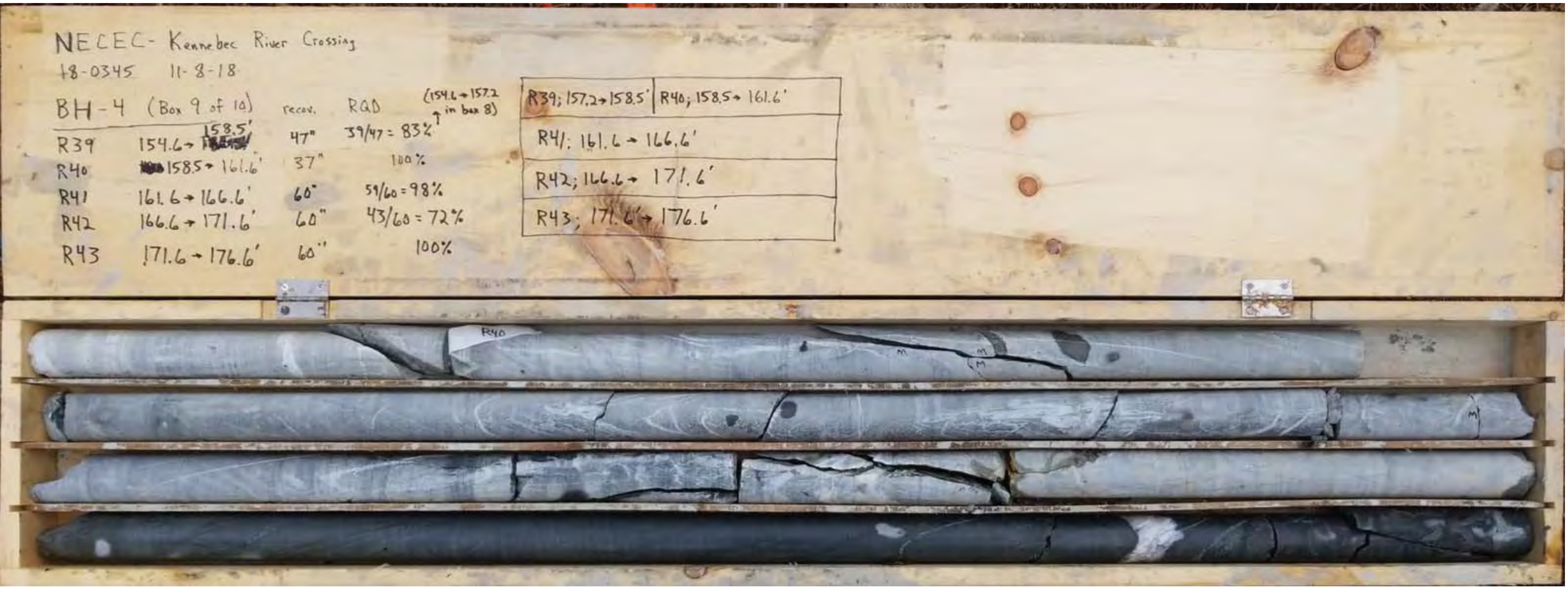

NECEC - Kennebec River Crossing
18-0345 11-6-18
BH-4 (Box 4 of 10) recov. RQD
R18 59.6 → 64.6' 60" 100%
R19 64.6 → 69.6' 60" 30/60 = 50%
R20 69.6 → 74.6' 57" 45/60 = 75%
R21 74.6 → 79.6' 60" 100%
R18; 59.6 → 64.6'
R19; 64.6 → 69.6'
R20; 69.5 → 74.6'
R21; 74.6 → 79.6'


NECEC - Kennebec River Crossing
18-0345 11-7-18
BH-4 (Box 5 of 10) recov. RQD
R22; 79.6→ 84.6' 60" 56/60 = 93%
R23; 84.6→89.6' 60" 100%
R24; 89.6→94.6' 60" 100%
R25; 94.6→99.6' 60" 100%
R22; 79.6→ 84.6'
R23; 84.6→ 89.6'
R24; 89.6→ 94.6'
R25; 94.6→ 99.6'


NECEC - Kennebec River Crossing
18-0345 11-7-18
BH-4 (Box 6 of 10) recov. RQD
R26; 99.6 → 102.5' 35" 100%
R27 102.5 → 104.6' 25" 100%
R28 104.6 → 108.9' 51" 48/52 = 92%
R29 108.9 → 114.0' 61" 100%
R30 114.0 → 117.5' 42" 0%
R31 117.5 → 119.0' 18" 0
R26; 99.6 → 102.5'
R27; 102.5 → 104.6'
R28; 104.6 → 108.9'
R29; 108.9 → 109.6'
R29; 109.6 → 114.0'
R30; 114.0 → 114.6'
R30; 114.6 → 117.5'
R31; 117.5 → 119.0'
R27
R29
R30
R31


NECEC - Kennebec River Crossing
18-0345 11-7-18
BH-4 (Box 7 of 10) recov. RQD
R32 119.0 → 124.2 62" 29/62 = 47%
R33 124.2 → 129.4' 62" 100%
R34 129.4 → 134.6' 62" 100%
R35 134.6 → 139.6' 60" 34/60 = 57%
(↳ 138.5 → 139.6 in box 8)
R32; 119.0 → 123.5'
R32; 123.5 → 124.2'
R33; 124.2 → 128.5'
R33; 128.5 → 129.4'
R34; 129.4 → 133.5'
R34 133.5 → 134.6'
R35; 134.6 → 138.5'
R33
R34
R35


NECEC - Kennebec River Crossing
18-0345 11-8-18
BH-4 (Box 8 of 10) recov. RQD
R35 134.6 → 139.6' 60" 34/60 = 57%
(134.6 → 138.5' in box 7)
R36 139.6 → 144.6' 60" 58/60 = 97%
R37 144.6 → 149.6' 60" 50/60 = 83%
R38 149.6 → 154.6' 60" 56/60 = 93%
R39 154.6 → 158.5' 47" 39/47 = 83%
(157.2 → 158.5' in box 9)
R35; 138.5 → 139.6'
R36; 139.6 → 143.5'
R36; 143.5 → 144.6'
R37; 144.6 → 148.5'
R37; 148.5 → 149.6'
R38; 149.6' → 153.4'
R38; 153.4 → 154.6'
R39; 154.6 → 157.2
R37
R38


NECEC- Kennebec River Crossing
18-0345 11-8-18
BH-4 (Box 9 of 10) recov. RQD (154.6 → 157.2 in box 8)
R39 154.6 → 158.5' 47" 39/47 = 83%
R40 158.5 → 161.6' 37" 100%
R41 161.6 → 166.6' 60" 59/60 = 98%
R42 166.6 → 171.6' 60" 43/60 = 72%
R43 171.6 → 176.6' 60" 100%
R39; 157.2 → 158.5'
R40; 158.5 → 161.6'
R41; 161.6 → 166.6'
R42; 166.6 → 171.6'
R43; 171.6' → 176.6'
R40
M


NECEC - Kennebec River Crossing
18-0345 11-8-18
BH-4 (Box 10 of 10) recov. RQD
R44 176.6→181.6' 60" 47/60=78%
R45 181.6→186.6' 60" 38/60=63%
R46 186.6→191.6' 60" 56/60=93%
R47 191.6→193.4' 22" 100%
R44; 176.6→181.6'
R45; 181.6→186.6'
R46; 186.6→191.6'
R47; 191.6'→193.4'


NECEC - Kennebec River Crossing
18-0345 11-5-18
BH-5
recov RQD
R1 24.0→27.6' 26" 7/43 = 16%
R2 27.6→30.0' 29" 11/29 = 38%
BH-5; R1, 24.0→27.6'
BH-5; R2, 27.6→30.0'
R2

APPENDIX D

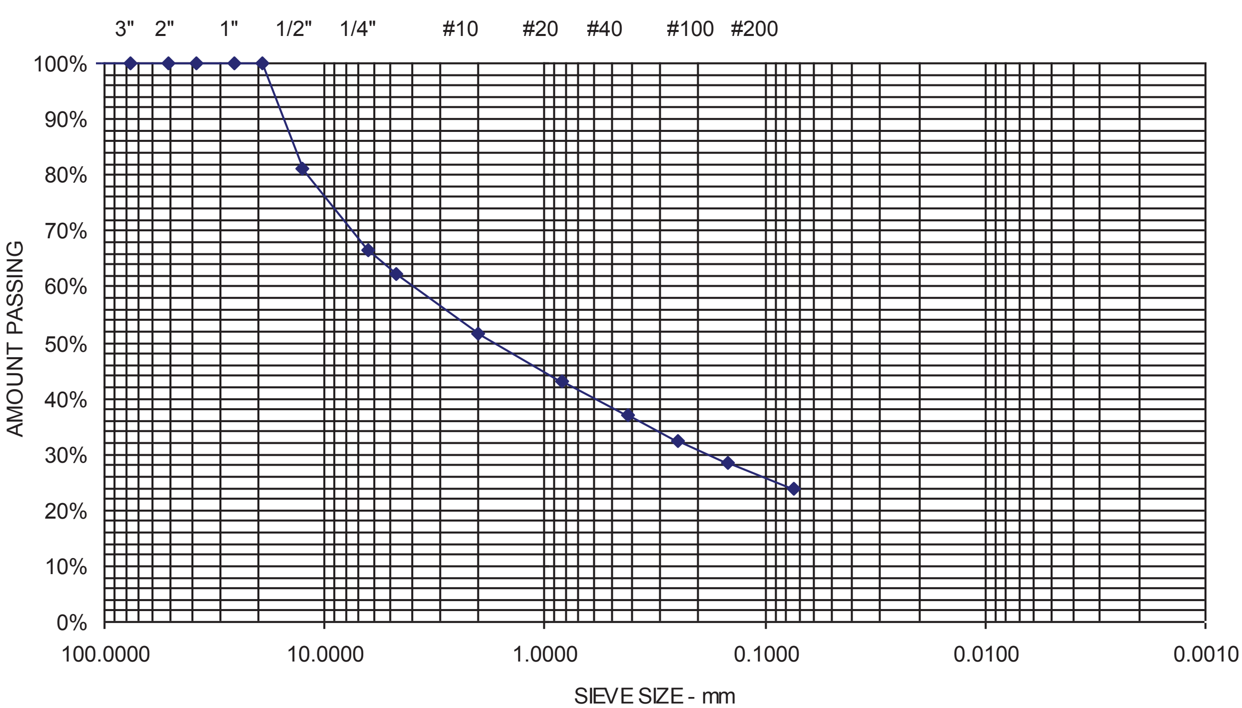
Laboratory Geotechnical and Analytical Test Results

Report of Gradation

ASTM C-117 & C-136

Project Name	THE FORKS ME - NEW ENGLAND CLEAN ENERGY PROJECT - KENNEBEC RIVER CROSSING - GEOTECHNICAL ENGINEERING	Project Number	18-0345
Client	CENTRAL MAINE POWER COMPANY	Lab ID	22228B
Exploration	**3D**	Date Received	11/3/2018
Material Source	**BH-1, 5-7'**	Date Completed	11/6/2018
		Tested By	THOMAS HIGGINS

STANDARD DESIGNATION (mm/µm)	SIEVE SIZE	AMOUNT PASSING (%)	
150	**6"**	**100**	
125	**5"**	**100**	
100	**4"**	**100**	
75	**3"**	**100**	
50	**2"**	**100**	
38.1	**1-1/2"**	**100**	
25.0	**1"**	**100**	
19.0	**3/4"**	**100**	
12.5	**1/2"**	**81**	
6.3	**1/4"**	**67**	
4.75	**No. 4**	**62**	37.8% Gravel
2.00	**No. 10**	**52**	
850	**No. 20**	**43**	
425	**No. 40**	**37**	38.4% Sand
250	**No. 60**	**32**	
150	**No. 100**	**29**	
75	**No. 200**	**23.8**	23.8% Fines



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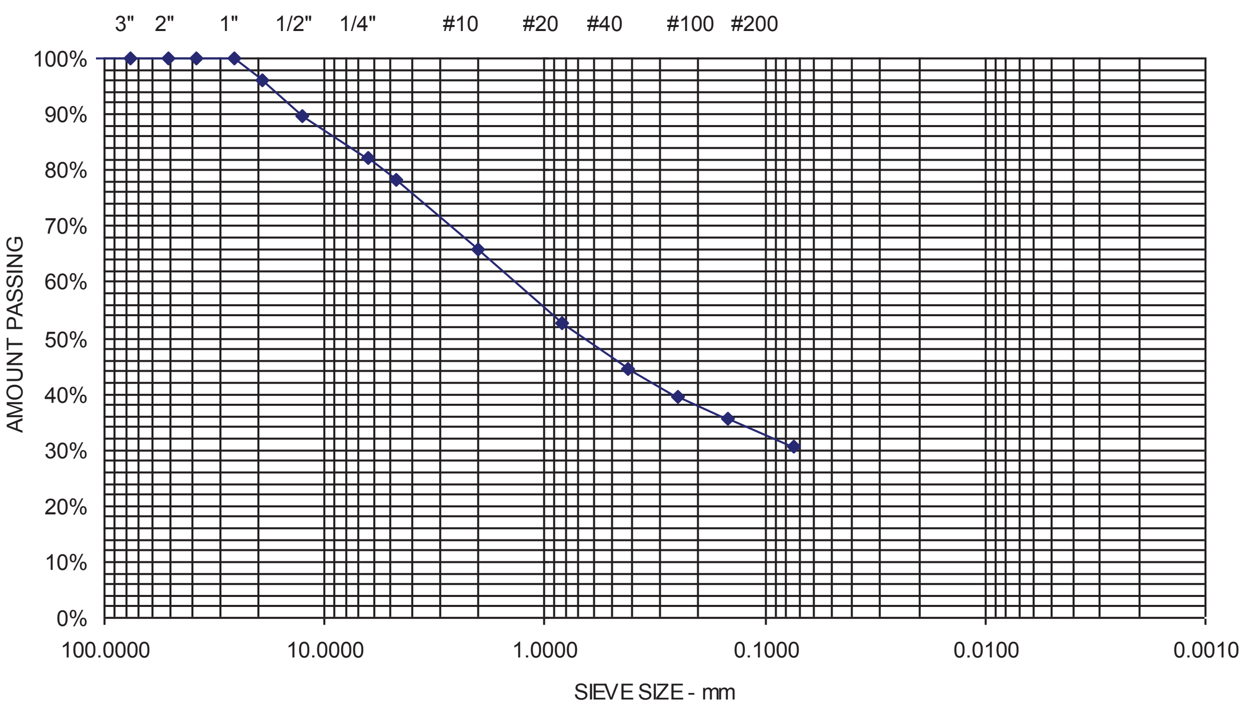
Report of Gradation

ASTM C-117 & C-136

Project Name	THE FORKS ME - NEW ENGLAND CLEAN ENERGY PROJECT - KENNEBEC RIVER CROSSING - GEOTECHNICAL ENGINEERING	Project Number	18-0345
Client	CENTRAL MAINE POWER COMPANY	Lab ID	22229B
Exploration	**2D**	Date Received	11/3/2018
Material Source	**BH-2, 2-4'**	Date Completed	11/6/2018
		Tested By	THOMAS HIGGINS

STANDARD DESIGNATION (mm/µm)	SIEVE SIZE	AMOUNT PASSING (%)	
150	**6"**	**100**	
125	**5"**	**100**	
100	**4"**	**100**	
75	**3"**	**100**	
50	**2"**	**100**	
38.1	**1-1/2"**	**100**	
25.0	**1"**	**100**	
19.0	**3/4"**	**96**	
12.5	**1/2"**	**90**	
6.3	**1/4"**	**82**	
4.75	**No. 4**	**78**	21.5% Gravel
2.00	**No. 10**	**66**	
850	**No. 20**	**53**	
425	**No. 40**	**45**	47.7% Sand
250	**No. 60**	**39**	
150	**No. 100**	**35**	
75	**No. 200**	**30.7**	30.7% Fines



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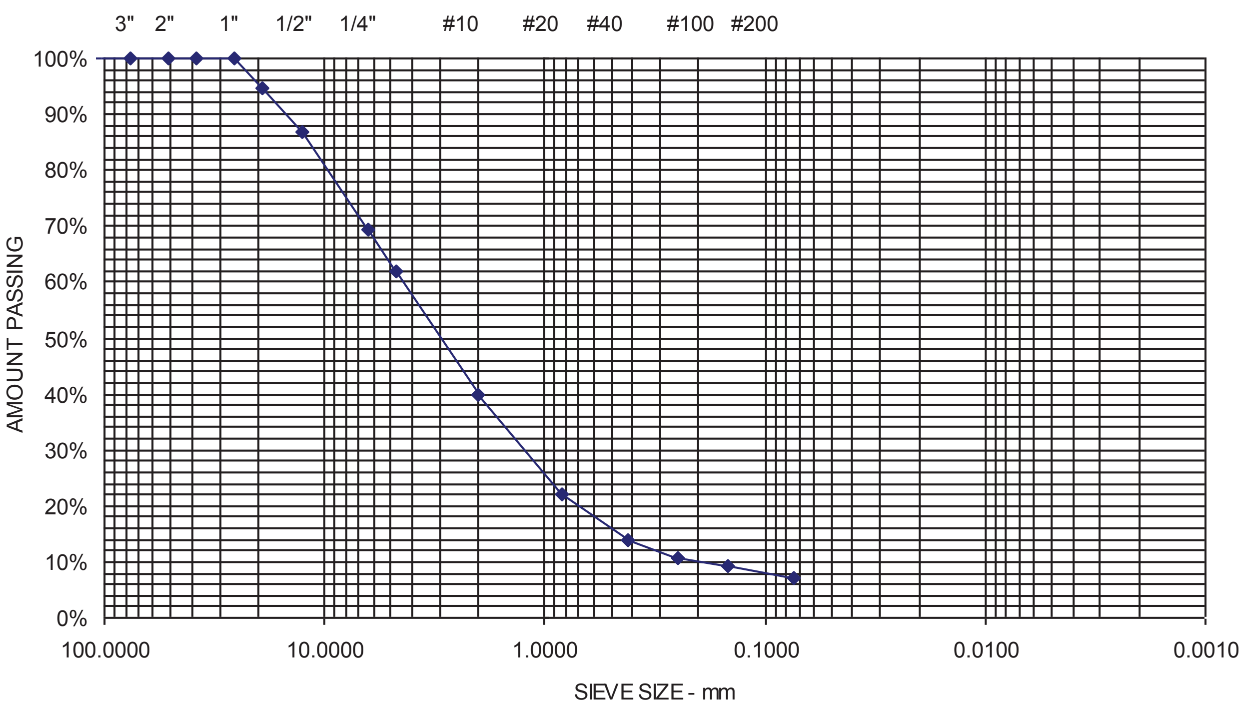
Report of Gradation

ASTM C-117 & C-136

Project Name	THE FORKS ME - NEW ENGLAND CLEAN ENERGY PROJECT - KENNEBEC RIVER CROSSING - GEOTECHNICAL ENGINEERING	Project Number	18-0345
Client	CENTRAL MAINE POWER COMPANY	Lab ID	22272B
Exploration	**S-1**	Date Received	11/30/2018
Material Source	**BH-3, 2-5'**	Date Completed	12/3/2018
		Tested By	THOMAS HIGGINS

STANDARD DESIGNATION (mm/µm)	SIEVE SIZE	AMOUNT PASSING (%)	
150	**6"**	**100**	
125	**5"**	**100**	
100	**4"**	**100**	
75	**3"**	**100**	
50	**2"**	**100**	
38.1	**1-1/2"**	**100**	
25.0	**1"**	**100**	
19.0	**3/4"**	**95**	
12.5	**1/2"**	**87**	
6.3	**1/4"**	**69**	
4.75	**No. 4**	**62**	38.2% Gravel
2.00	**No. 10**	**40**	
850	**No. 20**	**22**	
425	**No. 40**	**14**	54.6% Sand
250	**No. 60**	**11**	
150	**No. 100**	**9**	
75	**No. 200**	**7.2**	7.2% Fines



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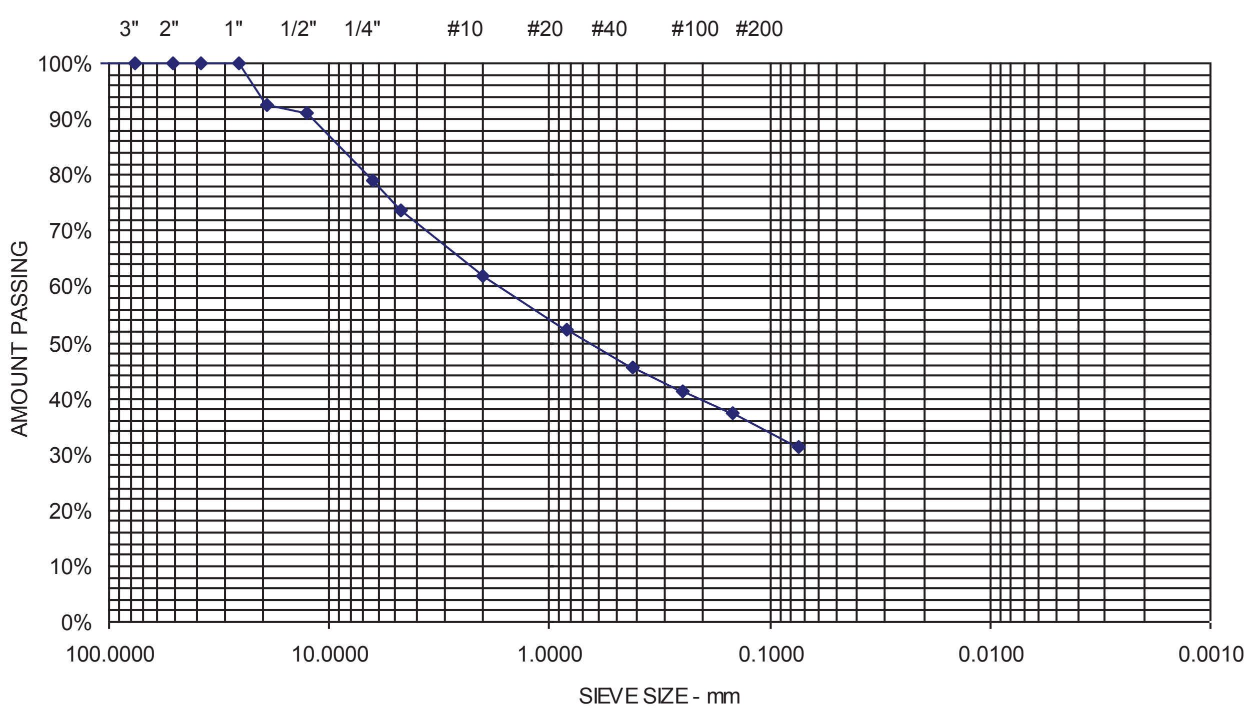
Report of Gradation

ASTM C-117 & C-136

Project Name	THE FORKS ME - NEW ENGLAND CLEAN ENERGY PROJECT - KENNEBEC RIVER CROSSING - GEOTECHNICAL ENGINEERING	Project Number	18-0345
Client	CENTRAL MAINE POWER COMPANY	Lab ID	22236B
Exploration	**2D**	Date Received	11/10/2018
Material Source	**BH-4, 2-3.3'**	Date Completed	11/14/2018
		Tested By	SEAN GIROUX

STANDARD DESIGNATION (mm/µm)	SIEVE SIZE	AMOUNT PASSING (%)	
150	**6"**	**100**	
125	**5"**	**100**	
100	**4"**	**100**	
75	**3"**	**100**	
50	**2"**	**100**	
38.1	**1-1/2"**	**100**	
25.0	**1"**	**100**	
19.0	**3/4"**	**93**	
12.5	**1/2"**	**91**	
6.3	**1/4"**	**79**	
4.75	**No. 4**	**74**	26.4% Gravel
2.00	**No. 10**	**62**	
850	**No. 20**	**52**	
425	**No. 40**	**46**	42.1% Sand
250	**No. 60**	**41**	
150	**No. 100**	**37**	
75	**No. 200**	**31.4**	31.4% Fines



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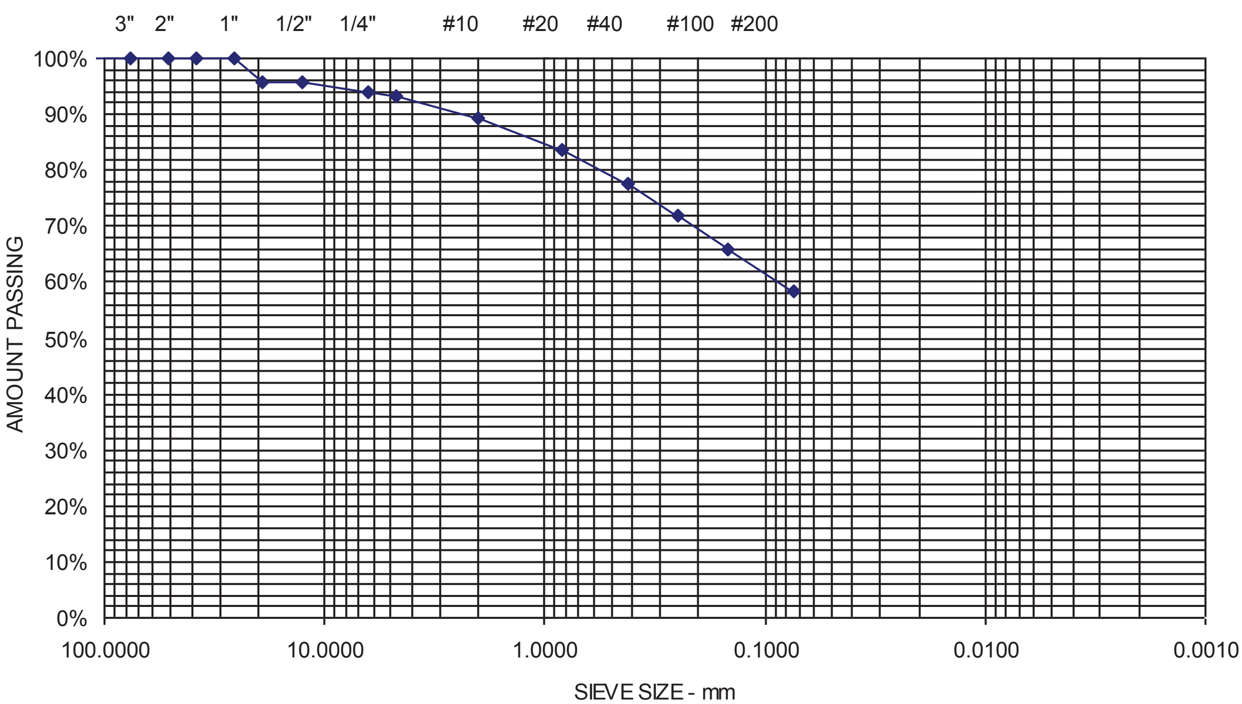
Report of Gradation

ASTM C-117 & C-136

Project Name	THE FORKS ME - NEW ENGLAND CLEAN ENERGY PROJECT - KENNEBEC RIVER CROSSING - GEOTECHNICAL ENGINEERING	Project Number	18-0345
Client	CENTRAL MAINE POWER COMPANY	Lab ID	22230B
Exploration	**4D**	Date Received	11/3/2018
Material Source	**BH-5, 10-12'**	Date Completed	11/6/2018
		Tested By	SEAN GIROUX

STANDARD DESIGNATION (mm/µm)	SIEVE SIZE	AMOUNT PASSING (%)	
150	**6"**	**100**	
125	**5"**	**100**	
100	**4"**	**100**	
75	**3"**	**100**	
50	**2"**	**100**	
38.1	**1-1/2"**	**100**	
25.0	**1"**	**100**	
19.0	**3/4"**	**96**	
12.5	**1/2"**	**96**	
6.3	**1/4"**	**94**	
4.75	**No. 4**	**93**	6.9% Gravel
2.00	**No. 10**	**89**	
850	**No. 20**	**84**	
425	**No. 40**	**77**	34.9% Sand
250	**No. 60**	**72**	
150	**No. 100**	**66**	
75	**No. 200**	**58.2**	58.2% Fines



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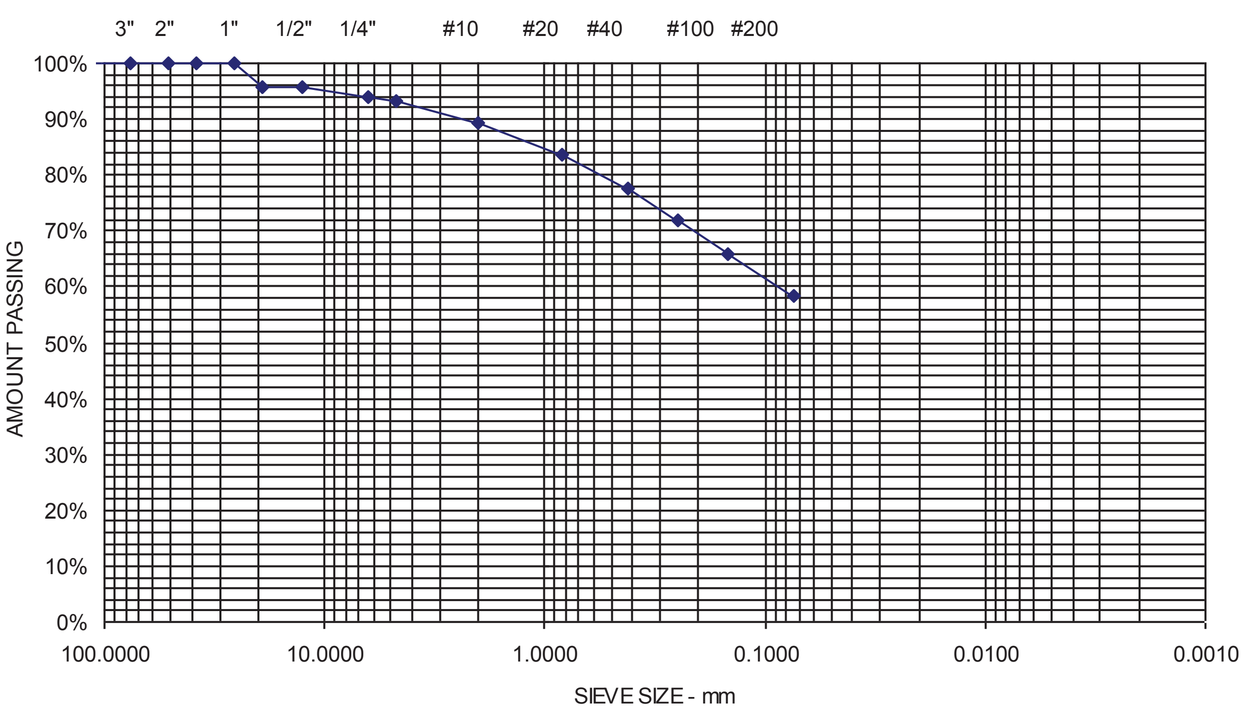
Report of Gradation

ASTM C-117 & C-136

Project Name	THE FORKS ME - NEW ENGLAND CLEAN ENERGY PROJECT - KENNEBEC RIVER CROSSING - GEOTECHNICAL ENGINEERING	Project Number	18-0345
Client	CENTRAL MAINE POWER COMPANY	Lab ID	22230B
Exploration	**4D**	Date Received	11/3/2018
Material Source	**BH-5, 10-12'**	Date Completed	11/6/2018
		Tested By	SEAN GIROUX

STANDARD DESIGNATION (mm/µm)	SIEVE SIZE	AMOUNT PASSING (%)	
150	**6"**	**100**	
125	**5"**	**100**	
100	**4"**	**100**	
75	**3"**	**100**	
50	**2"**	**100**	
38.1	**1-1/2"**	**100**	
25.0	**1"**	**100**	
19.0	**3/4"**	**96**	
12.5	**1/2"**	**96**	
6.3	**1/4"**	**94**	
4.75	**No. 4**	**93**	6.9% Gravel
2.00	**No. 10**	**89**	
850	**No. 20**	**84**	
425	**No. 40**	**77**	34.9% Sand
250	**No. 60**	**72**	
150	**No. 100**	**66**	
75	**No. 200**	**58.2**	58.2% Fines



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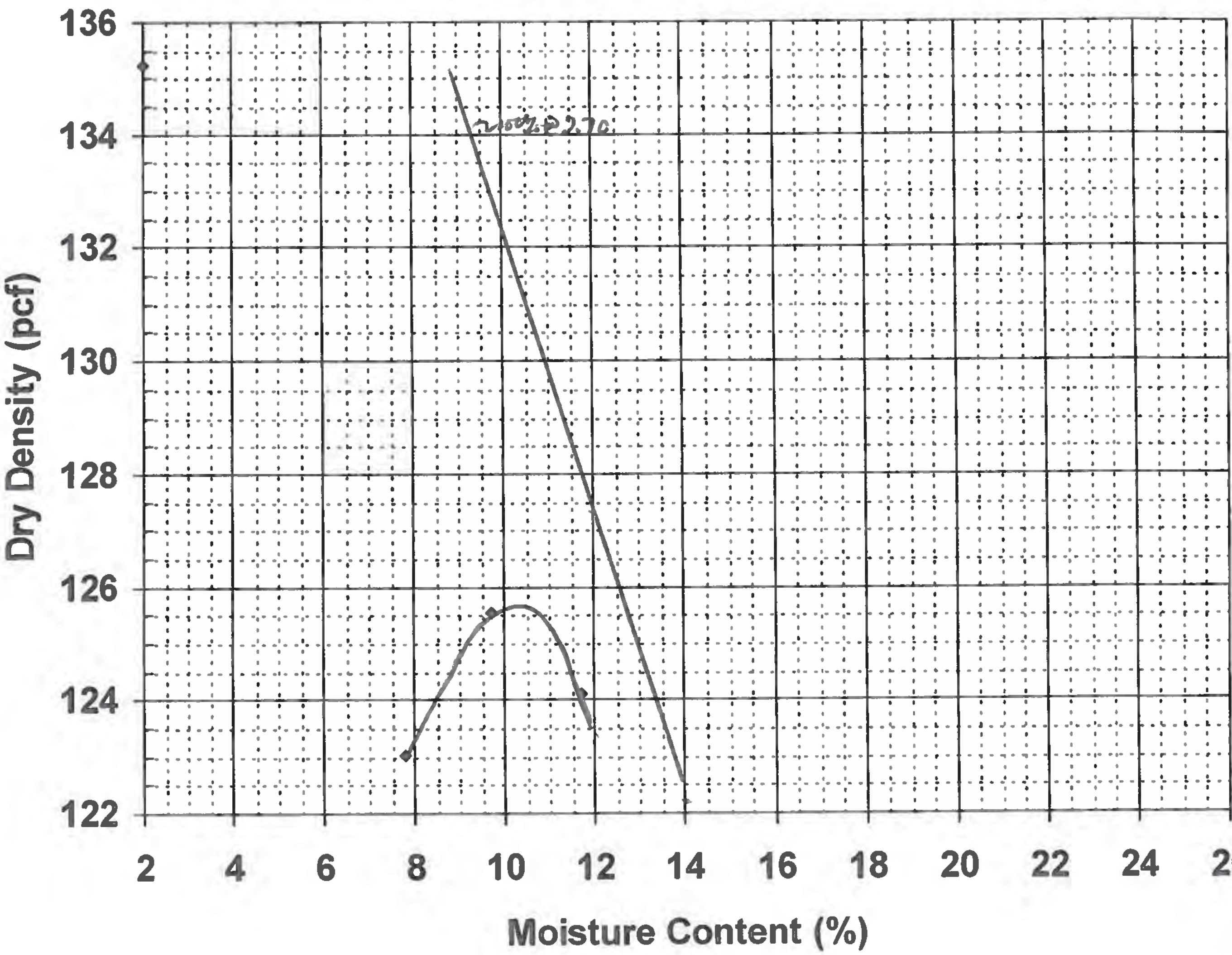
S.W.COLE ENGINEERING, INC.

Report of Moisture-Density

Method ASTM D-698 STANDARD   Procedure A

Project Name	THE FORKS ME - NEW ENGLAND CLEAN ENERGY PROJECT - KENNEBEC RIVER CROSSING - GEOTECHNICAL	Project Number	18-0345
Client	CENTRAL MAINE POWER COMPANY	Lab ID	22221B
Material Type	GLACIAL TILL	Date Received	11/1/2018
Material Source	BH-2, 1 - 8'	Date Completed	11/2/2018
		Tested By	CHRISTOPHER RAYMOND

Moisture-Density Relationship Curve



Maximum Dry Density (pcf)	125.6
Optimum Moisture Content (%)	10.4
Percent Oversized	13.1%

Corrected Dry Density (pcf)	129
Corrected Moisture Content (%)	9.3

Comments

Thomas J. Higgins

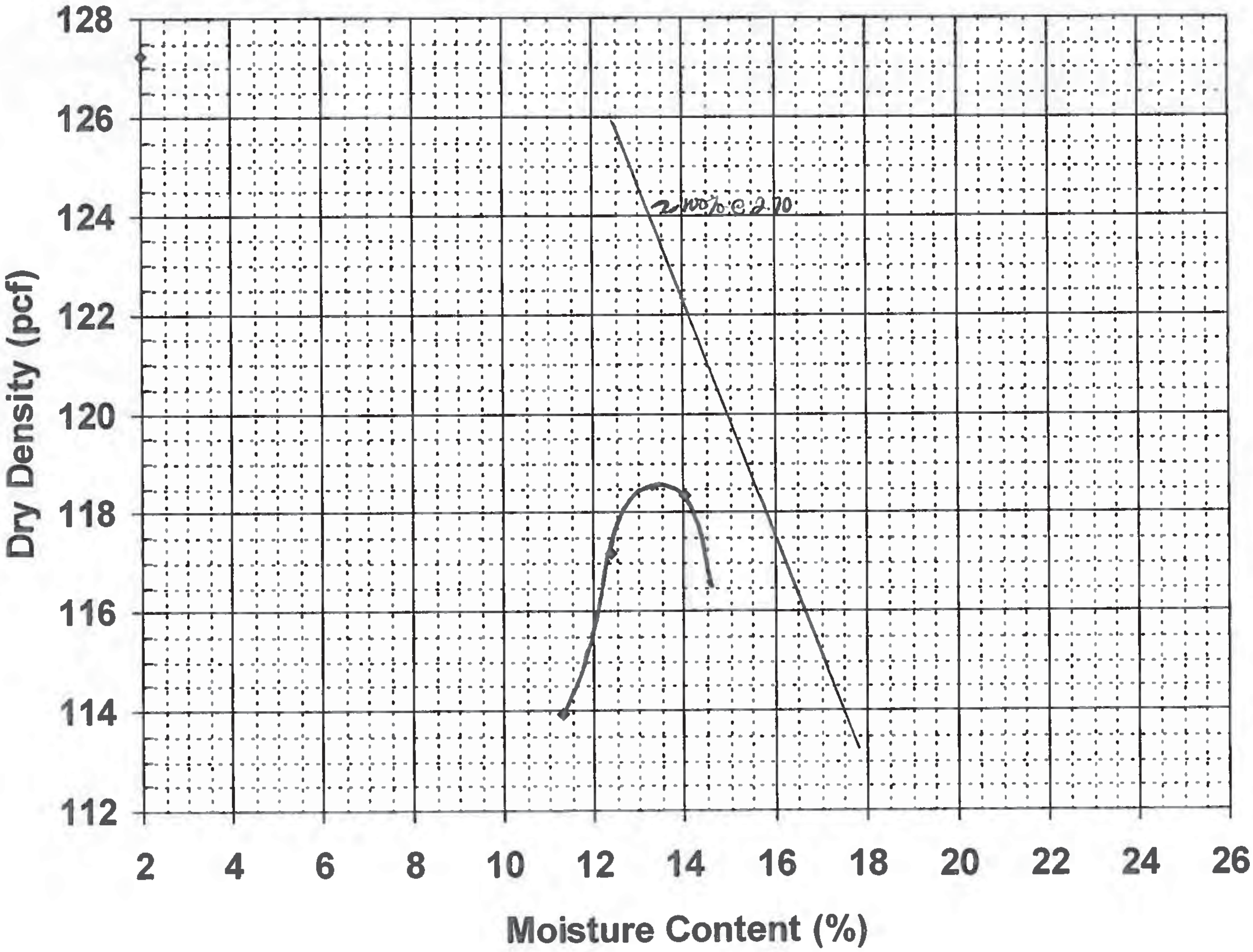
S.W.COLE ENGINEERING, INC.

Report of Moisture-Density

Method ASTM D-698 STANDARD Procedure C

Project Name	THE FORKS ME - NEW ENGLAND CLEAN ENERGY PROJECT - KENNEBEC RIVER CROSSING - GEOTECHNICAL	Project Number	18-0345
Client	CENTRAL MAINE POWER COMPANY	Lab ID	22237B
Material Type	GLACIAL TILL	Date Received	11/10/2018
Material Source	BH-4, 1-2.5'	Date Completed	11/14/2018
		Tested By	STEPHEN PHILBROOK

Moisture-Density Relationship Curve



Maximum Dry Density (pcf)	118.6
Optimum Moisture Content (%)	13.4
Percent Oversized	9.2%

Corrected Dry Density (pcf)	**121.3**
Corrected Moisture Content (%)	**12.4**

Thomas J. Higgins

Thomas J. Higgins

Comments

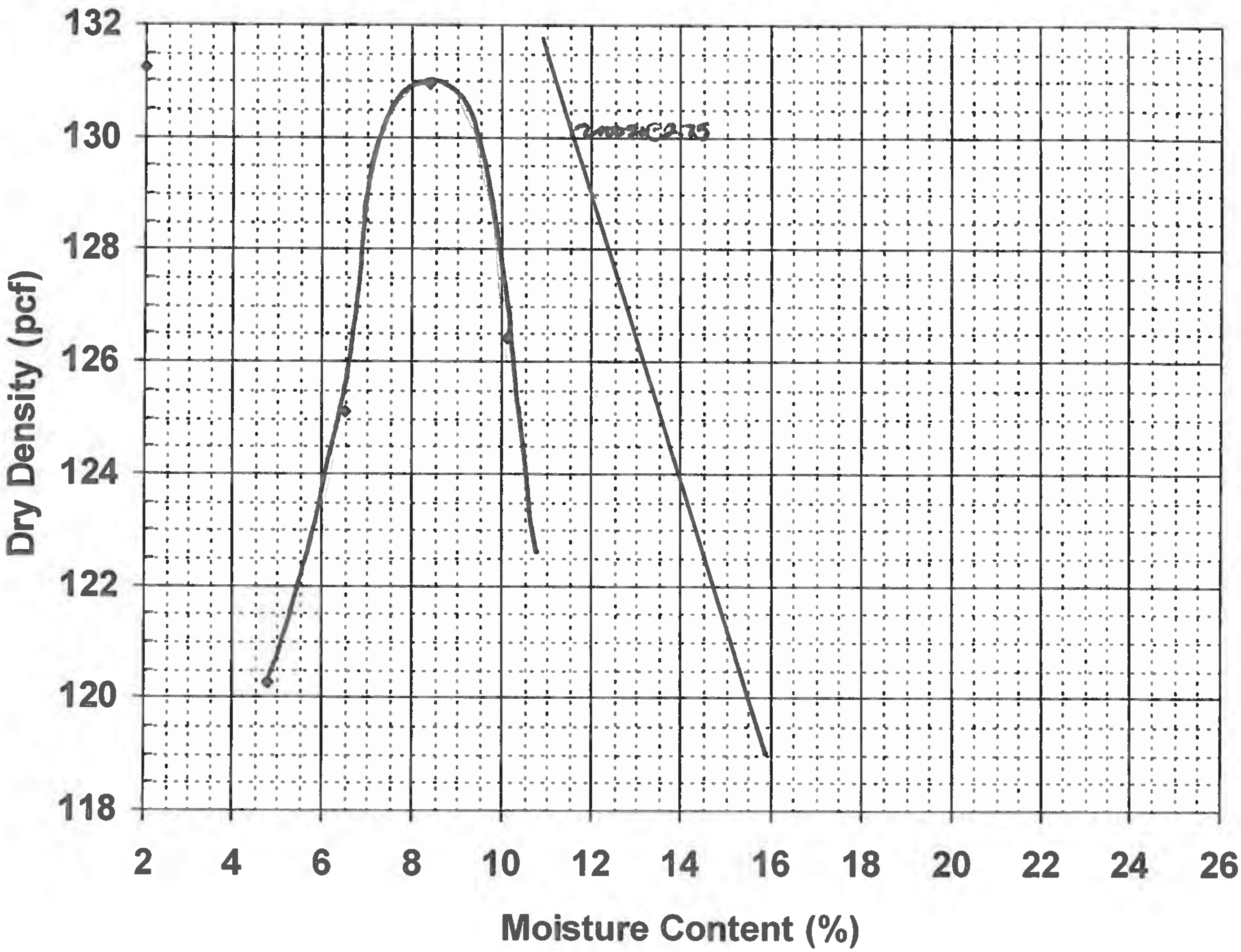
S.W.COLE ENGINEERING, INC.

Report of Moisture-Density

Method ASTM D-698 STANDARD   Procedure A

Project Name	THE FORKS ME - NEW ENGLAND CLEAN ENERGY PROJECT - KENNEBEC RIVER CROSSING - GEOTECHNICAL	Project Number	18-0345
Client	CENTRAL MAINE POWER COMPANY	Lab ID	22231B
Material Type	GLACIAL TILL	Date Received	11/3/2018
Material Source	BH-5, 5 - 10'	Date Completed	11/6/2018
		Tested By	CHRISTOPHER RAYMOND

Moisture-Density Relationship Curve



Maximum Dry Density (pcf)	131
Optimum Moisture Content (%)	8.5
Percent Oversized	11.5%

Corrected Dry Density (pcf)	133.6
Corrected Moisture Content (%)	7.8

Comments

Thomas J. Higgins

37 Liberty Drive, Bangor, ME 04401-5874 • Tel (207) 848-6029 • Fax (207) 848-2403 • www.swcole.com

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Transmittal

TO:
Paul Kohler
S.W. Cole Engineering, Inc.
286 Portland Road
Gray, ME 04039-9586

DATE: 12/26/2018	GTX NO: 309265
RE: NECEC/KRC	

COPIES	DATE	DESCRIPTION
	12/26/2018	**December 2018 Laboratory Test Report**

REMARKS:

SIGNED:
Jonathan Campbell, Assistant Laboratory Manager

CC:

APPROVED BY:
Mark Dobday, P.G., Laboratory Manager

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December 26, 2018

Paul Kohler
S.W. Cole Engineering, Inc.
286 Portland Road
Gray, ME 04039-9586

RE: NECEC/KRC, Maine (GTX-309265)

Dear Paul:

Enclosed are the test results you requested for the above referenced project. GeoTesting Express, Inc. (GTX) received 11 samples from you on 12/7/2018. These samples were labeled as follows:

Boring Number	Sample Number	Depth
R5	BH-1	19.1-20.5 ft
R9	BH-2	46.1-47.4 ft
R11	BH-2	54.5-55.8 ft
R14	BH-2	69.9-70.8 ft
R19	BH-3	79.2-81 ft
R21	BH-3	90.3-91.2 ft
R24	BH-3	100-101.1 ft
R26	BH-3	110-111.3 ft
R37	BH-4	46.8-48.5 ft
R40	BH-4	160.3-161.6 ft
R43	BH-4	174.9-175.7 ft

GTX performed the following tests on these samples:

10 ASTM D7012 Method C- Uniaxial Compressive Strength of Rock

Sample BH-2, R14, 69.9-70.8 ft fell apart during preparation. The assigned compression test could not be performed.

A copy of your test request is attached.

The results presented in this report apply only to the items tested. This report shall not be reproduced except in full, without written approval from GeoTesting Express. The remainder of these samples will be retained for a period of sixty (60) days and will then be discarded unless otherwise notified by you. Please call me if you have any questions or require additional information. Thank you for allowing GeoTesting Express the opportunity of providing you with testing services. We look forward to working with you again in the future.

Respectfully yours,

Jonathan Campbell
Assistant Laboratory Manager

GeoTesting
EXPRESS

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Geotechnical Test Report **12/26/2018**

GTX-309265

NECEC/KRC

Maine

Client Project No.: 18-0345

Prepared for:

S.W. Cole Engineering, Inc.

Client:	S.W. Cole Engineering, Inc.		
Project:	NECEC/KRC		
Location:	Maine	Project No:	GTX-309265
Boring ID: ---	Sample Type: ---	Tested By:	smd
Sample ID: ---	Test Date: 12/26/18	Checked By:	jsc
Depth : ---	Test Id: 484987		

Bulk Density and Compressive Strength of Rock Core Specimens by ASTM D7012 Method C

Boring ID	Sample Number	Depth	Bulk Density, pcf	Compressive strength, psi	Failure Type	Meets ASTM D4543	Note(s)
R5	BH-1	19.1-20.5	171	4376	2	Yes	---
R9	BH-2	46.21-46.60	170	5288	3	Yes	---
R11	BH-2	54.71-55.11	172	8494	3	Yes	---
R19	BH-3	79.67-80.09	170	17872	3	Yes	---
R21	BH-3	90.33-90.71	169	8376	3	Yes	---
R24	BH-3	100.36-100.78	168	8529	3	No	2,*
R43	BH-4	174.99-175.38	169	7514	3	Yes	---

Notes: Density determined on core samples by measuring dimensions and weight and then calculating.

All specimens tested at the approximate as-received moisture content and at standard laboratory temperature.

The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.

Failure Type: 1 = Intact Material Failure; 2 = Discontinuity Failure; 3 = Intact Material and Discontinuity Failure (See attached photographs)

1: Best effort end preparation. See Tolerance report for details.
2: The as-received core did not meet the ASTM side straightness tolerance due to irregularities in the sample as cored.
3: Specimen L/D < 2.
4: The as-received core did not meet the ASTM minimum diameter tolerance of 1.875 inches.
5: Specimen diameter is less than 10 times maximum particle size.
6: Specimen diameter is less than 6 times maximum particle size.

*Because the indicated tested specimens did not meet the ASTM D4543 standard tolerances, the results reported here may differ from those for a test specimen within tolerances.

Client:	S.W. Cole Engineering, Inc.		
Project:	NECEC/KRC		
Location:	Maine	Project No:	GTX-309265

Boring ID:	---	Sample Type:	---	Tested By:	smd
Sample ID:	---	Test Date:	12/26/18	Checked By:	jsc
Depth :	---	Test Id:	484986		

Bulk Density and Compressive Strength of Rock Core Specimens by ASTM D7012 Method C

Boring ID	Sample Number	Depth	Bulk Density, pcf	Compressive strength, psi	Failure Type	Meets ASTM D4543	Note(s)
R26	BH-3	110.25-110.65	169	12949	3	Yes	---
R37	BH-4	46.92-47.33	174	14526	3	Yes	---
R40	BH-4	160.66-161.06	168	12715	3	Yes	---

Notes: Density determined on core samples by measuring dimensions and weight and then calculating.

All specimens tested at the approximate as-received moisture content and at standard laboratory temperature.

The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.

Failure Type: 1 = Intact Material Failure; 2 = Discontinuity Failure; 3 = Intact Material and Discontinuity Failure
(See attached photographs)

GeoTesting EXPRESS

Client:	S.W. Cole Engineering, Inc.	Test Date:	12/17/2018
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	R5		
Sample ID:	BH-1		
Depth:	19.1-20.5 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.54	4.54	4.54
Specimen Diameter, in:	2.00	2.00	2.00
Specimen Mass, g:	641.6		
Bulk Density, lb/ft^3	171		
Length to Diameter Ratio:	2.3		

Minimum Diameter Tolerence Met? YES
Length to Diameter Ratio Tolerance Met? YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

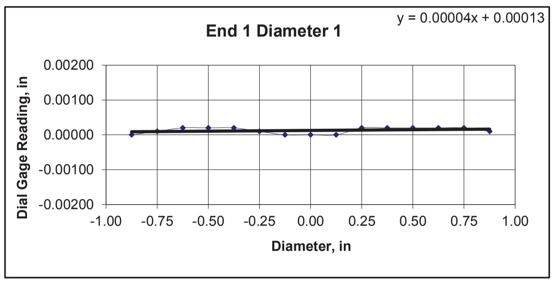
END FLATNESS AND PARALLELISM (Procedure FP1)

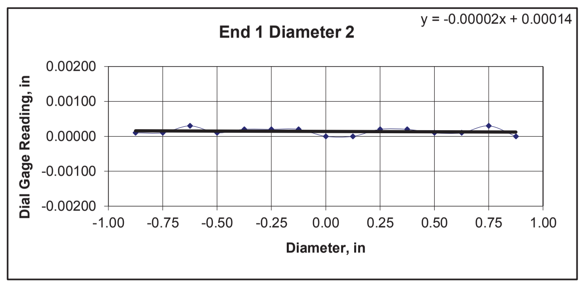
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00010	0.00020	0.00020	0.00020	0.00010	0.00000	0.00000	0.00000	0.00020	0.00020	0.00020	0.00020	0.00020	0.00010
Diameter 2, in (rotated 90°)	0.00010	0.00010	0.00030	0.00010	0.00020	0.00020	0.00020	0.00000	0.00000	0.00020	0.00020	0.00010	0.00010	0.00030	0.00000

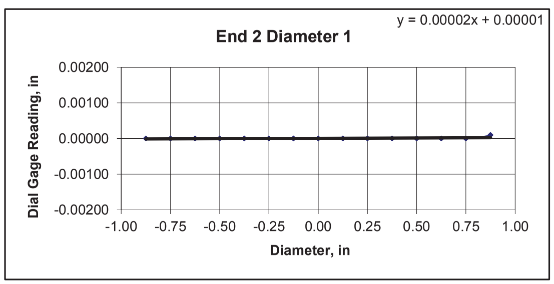
Difference between max and min readings, in:
0° = 0.00020 90° = 0.00030

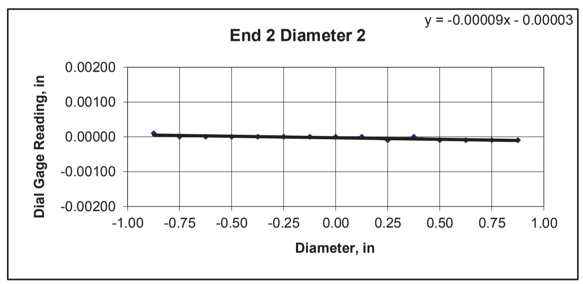
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010
Diameter 2, in (rotated 90°)	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	0.00000	-0.00010	-0.00010	-0.00010	-0.00010

Difference between max and min readings, in:
0° = 0.0001 90° = 0.0002
Maximum difference must be < 0.0020 in. Difference = ± 0.00015
Flatness Tolerance Met? YES









DIAMETER 1

End 1:	Slope of Best Fit Line	0.00004
	Angle of Best Fit Line:	0.00246
End 2:	Slope of Best Fit Line	0.00002
	Angle of Best Fit Line:	0.00115
Maximum Angular Difference:		0.00131

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:	Slope of Best Fit Line	0.00002
	Angle of Best Fit Line:	0.00115
End 2:	Slope of Best Fit Line	0.00009
	Angle of Best Fit Line:	0.00507
Maximum Angular Difference:		0.00393

Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00020	2.000	0.00010	0.006	YES
Diameter 2, in (rotated 90°)	0.00030	2.000	0.00015	0.009	YES
END 2					
Diameter 1, in	0.00010	2.000	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00020	2.000	0.00010	0.006	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

GeoTesting EXPRESS

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	12/24/2018
Tested By:	cmh
Checked By:	jsc
Boring ID:	R5
Sample ID:	BH-1
Depth, ft:	19.1-20.5

After cutting and grinding

After break

GeoTesting EXPRESS

Client:	S.W. Cole Engineering, Inc.	Test Date:	12/17/2018
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	R9		
Sample ID:	BH-2		
Depth:	46.21-46.60 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.48	4.48	4.48
Specimen Diameter, in:	2.00	2.00	2.00
Specimen Mass, g:	627.37		
Bulk Density, lb/ft^3	170		
Length to Diameter Ratio:	2.2		

Minimum Diameter Tolerence Met? YES
Length to Diameter Ratio Tolerance Met? YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

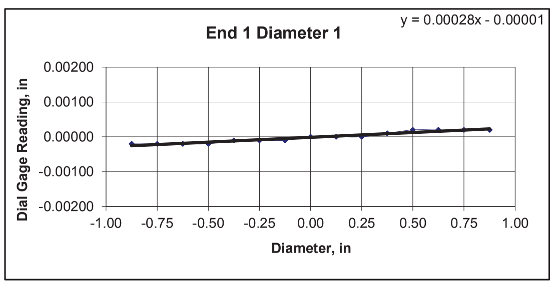
END FLATNESS AND PARALLELISM (Procedure FP1)

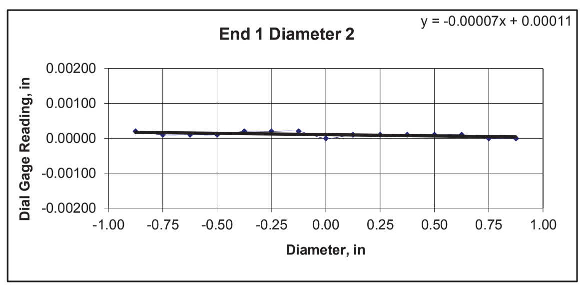
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00020	-0.00020	-0.00020	-0.00020	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00010	0.00020	0.00020	0.00020	0.00020
Diameter 2, in (rotated 90°)	0.00020	0.00010	0.00010	0.00010	0.00020	0.00020	0.00020	0.00000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000	0.00000

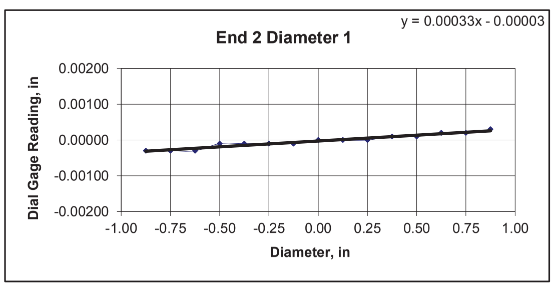
Difference between max and min readings, in:
0° = 0.00040 90° = 0.00020

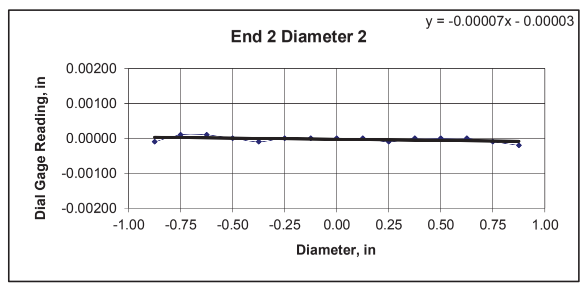
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00030	-0.00030	-0.00030	-0.00010	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00010	0.00010	0.00020	0.00020	0.00030
Diameter 2, in (rotated 90°)	-0.00010	0.00010	0.00010	0.00000	-0.00010	0.00000	0.00000	0.00000	0.00000	-0.00010	0.00000	0.00000	0.00000	-0.00010	-0.00020

Difference between max and min readings, in:
0° = 0.0006 90° = 0.0003
Maximum difference must be < 0.0020 in. Difference = ± 0.00030
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00028
Angle of Best Fit Line: 0.01588

End 2:
Slope of Best Fit Line 0.00033
Angle of Best Fit Line: 0.01866

Maximum Angular Difference: 0.00278

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00007
Angle of Best Fit Line: 0.00426

End 2:
Slope of Best Fit Line 0.00007
Angle of Best Fit Line: 0.00377

Maximum Angular Difference: 0.00049

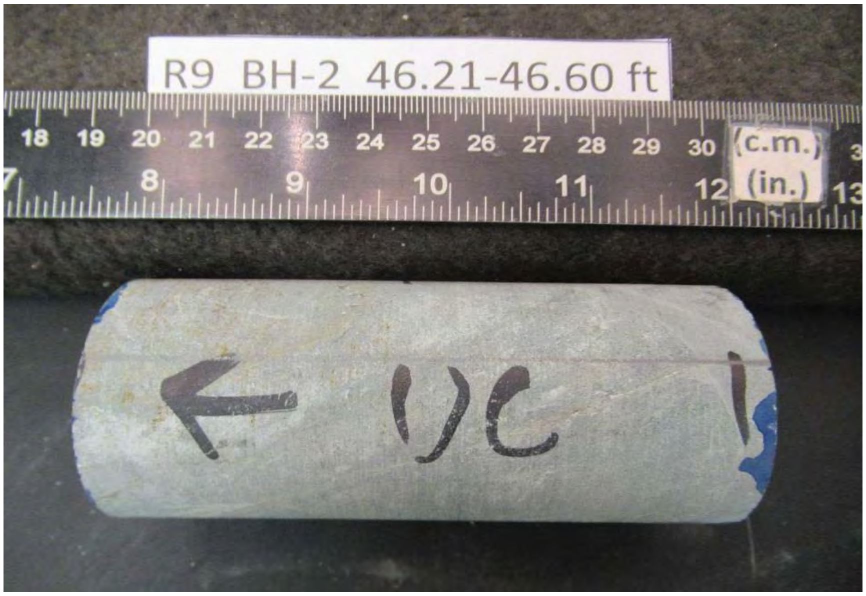
Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00040	2.000	0.00020	0.011	YES
Diameter 2, in (rotated 90°)	0.00020	2.000	0.00010	0.006	YES
END 2					
Diameter 1, in	0.00060	2.000	0.00030	0.017	YES
Diameter 2, in (rotated 90°)	0.00030	2.000	0.00015	0.009	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	12/24/2018
Tested By:	cmh
Checked By:	jsc
Boring ID:	R9
Sample ID:	BH-2
Depth, ft:	46.21-46.60



After cutting and grinding

After break

Client:	S.W. Cole Engineering, Inc.	Test Date:	12/17/2018
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	R11		
Sample ID:	BH-2		
Depth:	54.71-55.11 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.52	4.52	4.52
Specimen Diameter, in:	2.00	2.00	2.00
Specimen Mass, g:	641.27		
Bulk Density, lb/ft^3	172		
Length to Diameter Ratio:	2.3		

Minimum Diameter Tolerence Met? YES
Length to Diameter Ratio Tolerance Met? YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

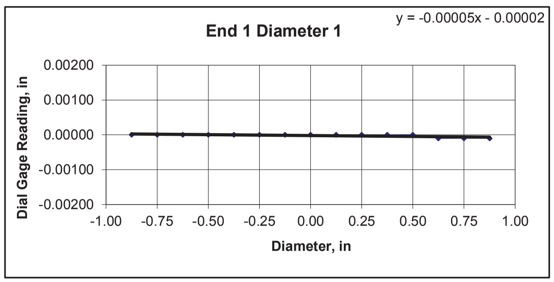
END FLATNESS AND PARALLELISM (Procedure FP1)

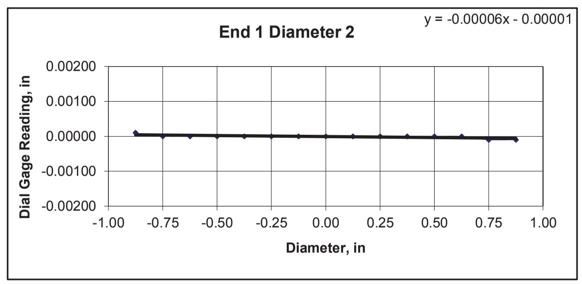
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010
Diameter 2, in (rotated 90°)	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010

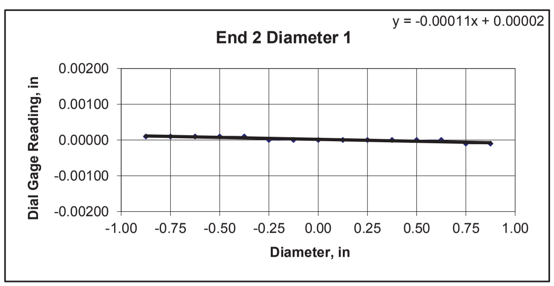
Difference between max and min readings, in:
0° = 0.00010 90° = 0.00020

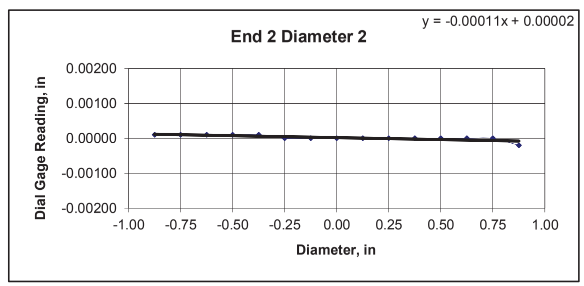
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010
Diameter 2, in (rotated 90°)	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00020

Difference between max and min readings, in:
0° = 0.0002 90° = 0.0003
Maximum difference must be < 0.0020 in. Difference = ± 0.00015
Flatness Tolerance Met? YES









DIAMETER 1

End 1:	Slope of Best Fit Line	0.00005
	Angle of Best Fit Line:	0.00295
End 2:	Slope of Best Fit Line	0.00011
	Angle of Best Fit Line:	0.00622
Maximum Angular Difference:		0.00327

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:	Slope of Best Fit Line	0.00006
	Angle of Best Fit Line:	0.00327
End 2:	Slope of Best Fit Line	0.00011
	Angle of Best Fit Line:	0.00638
Maximum Angular Difference:		0.00311

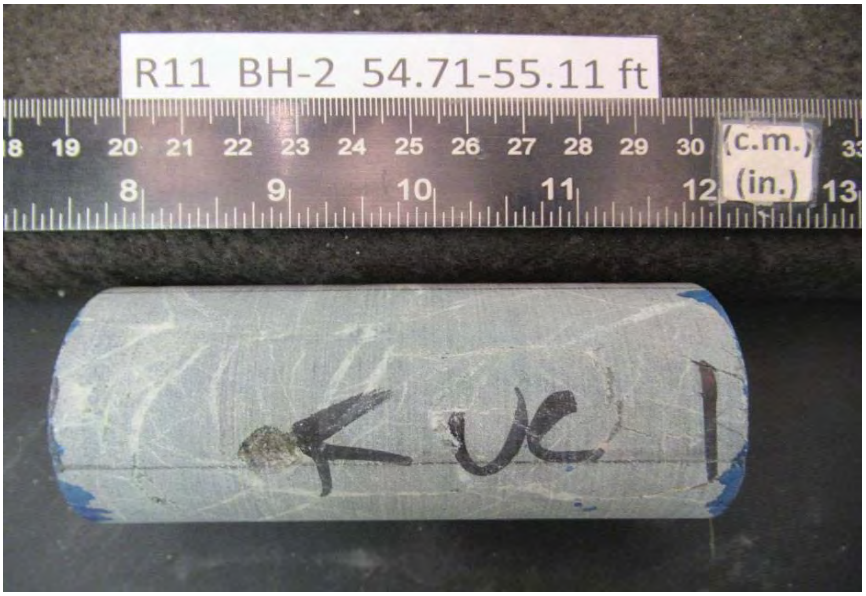
Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00010	2.000	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00020	2.000	0.00010	0.006	YES
END 2					
Diameter 1, in	0.00020	2.000	0.00010	0.006	YES
Diameter 2, in (rotated 90°)	0.00030	2.000	0.00015	0.009	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	12/24/2018
Tested By:	cmh
Checked By:	jsc
Boring ID:	R11
Sample ID:	BH-2
Depth, ft:	54.71-55.11



After cutting and grinding

After break

Client:	S.W. Cole Engineering, Inc.	Test Date:	12/17/2018
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	R19		
Sample ID:	BH-3		
Depth:	79.67-80.09 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.63	4.63	4.63
Specimen Diameter, in:	1.99	1.99	1.99
Specimen Mass, g:	640.85		
Bulk Density, lb/ft^3	170		
Length to Diameter Ratio:	2.3		

Minimum Diameter Tolerence Met? YES
Length to Diameter Ratio Tolerance Met? YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

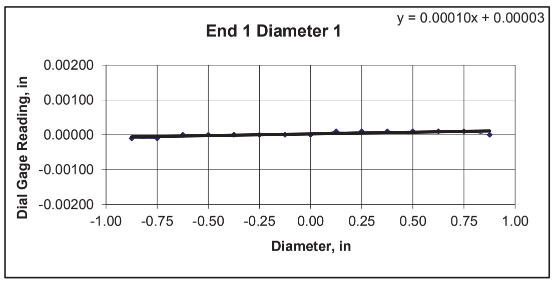
END FLATNESS AND PARALLELISM (Procedure FP1)

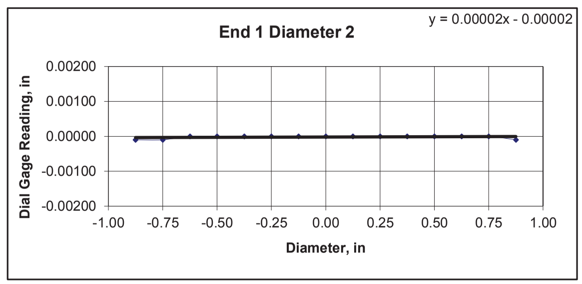
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000
Diameter 2, in (rotated 90°)	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010

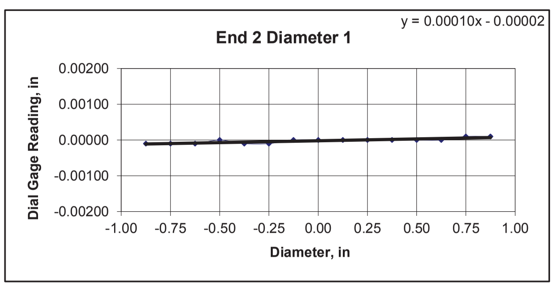
Difference between max and min readings, in:
0° = 0.00020 90° = 0.00010

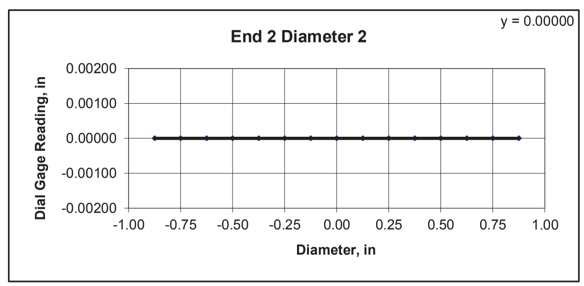
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00010	-0.00010	-0.00010	0.00000	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010
Diameter 2, in (rotated 90°)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Difference between max and min readings, in:
0° = 0.0002 90° = 0
Maximum difference must be < 0.0020 in. Difference = ± 0.00010
Flatness Tolerance Met? YES









DIAMETER 1

End 1:	
Slope of Best Fit Line	0.00010
Angle of Best Fit Line:	0.00557
End 2:	
Slope of Best Fit Line	0.00010
Angle of Best Fit Line:	0.00589
Maximum Angular Difference:	0.00033

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:	
Slope of Best Fit Line	0.00002
Angle of Best Fit Line:	0.00098
End 2:	
Slope of Best Fit Line	0.00000
Angle of Best Fit Line:	0.00000
Maximum Angular Difference:	0.00098

Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00020	1.990	0.00010	0.006	YES
Diameter 2, in (rotated 90°)	0.00010	1.990	0.00005	0.003	YES
END 2					
Diameter 1, in	0.00020	1.990	0.00010	0.006	YES
Diameter 2, in (rotated 90°)	0.00000	1.990	0.00000	0.000	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	12/24/2018
Tested By:	cmh
Checked By:	jsc
Boring ID:	R19
Sample ID:	BH-3
Depth, ft:	79.67-80.09

After cutting and grinding

After break

Client:	S.W. Cole Engineering, Inc.	Test Date:	12/17/2018
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	R21		
Sample ID:	BH-3		
Depth:	90.33-90.71 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.47	4.47	4.47
Specimen Diameter, in:	1.99	1.99	1.99
Specimen Mass, g:	617.77		
Bulk Density, lb/ft^3	169	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.2	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

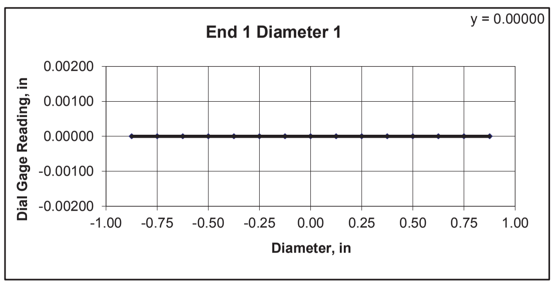
END FLATNESS AND PARALLELISM (Procedure FP1)

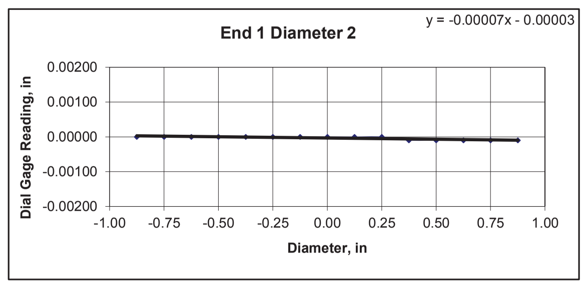
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010

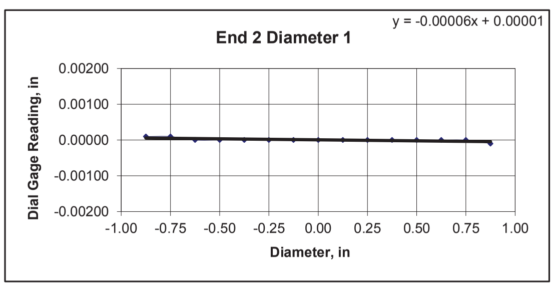
Difference between max and min readings, in:
0° = 0.00000 90° = 0.00010

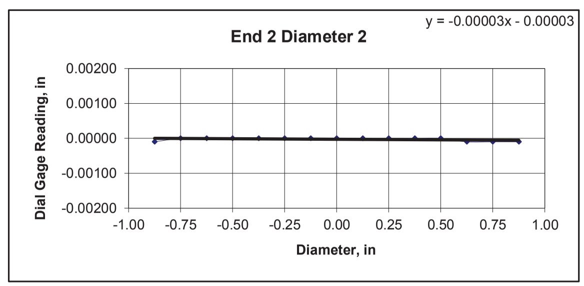
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010
Diameter 2, in (rotated 90°)	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010

Difference between max and min readings, in:
0° = 0.0002 90° = 0.0001
Maximum difference must be < 0.0020 in. Difference = ± 0.00010
Flatness Tolerance Met? YES









DIAMETER 1

End 1: Slope of Best Fit Line	0.00000
Angle of Best Fit Line:	0.00000
End 2: Slope of Best Fit Line	0.00006
Angle of Best Fit Line:	0.00327
Maximum Angular Difference:	0.00327

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1: Slope of Best Fit Line	0.00007
Angle of Best Fit Line:	0.00409
End 2: Slope of Best Fit Line	0.00003
Angle of Best Fit Line:	0.00180
Maximum Angular Difference:	0.00229

Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00000	1.990	0.00000	0.000	YES
Diameter 2, in (rotated 90°)	0.00010	1.990	0.00005	0.003	YES
END 2					
Diameter 1, in	0.00020	1.990	0.00010	0.006	YES
Diameter 2, in (rotated 90°)	0.00010	1.990	0.00005	0.003	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	12/24/2018
Tested By:	cmh
Checked By:	jsc
Boring ID:	R21
Sample ID:	BH-3
Depth, ft:	90.33-90.71

After cutting and grinding

After break

Client:	S.W. Cole Engineering, Inc.	Test Date:	12/24/2018
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	R24		
Sample ID:	BH-3		
Depth:	100.36-100.78 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.60	4.60	4.60
Specimen Diameter, in:	1.99	1.99	1.99
Specimen Mass, g:	629.88		
Bulk Density, lb/ft^3	168	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap $\leq$ 0.02 in.? NO

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? NO

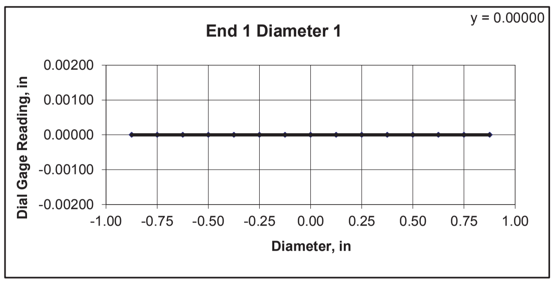
END FLATNESS AND PARALLELISM (Procedure FP1)

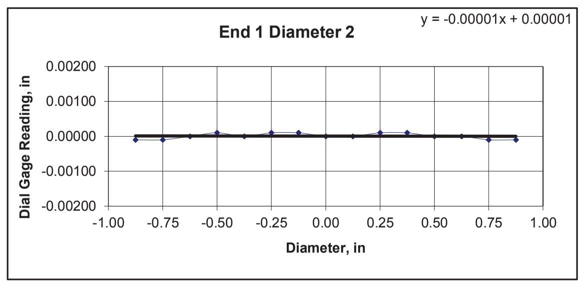
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	-0.00010	-0.00010	0.00000	0.00010	0.00000	0.00010	0.00010	0.00000	0.00000	0.00010	0.00010	0.00000	0.00000	-0.00010	-0.00010

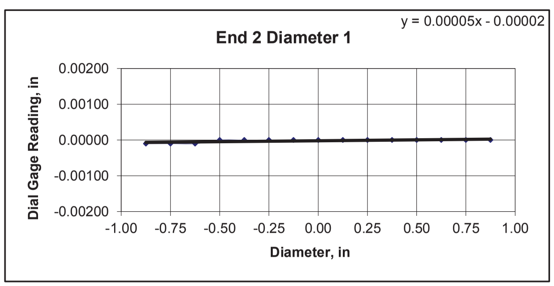
Difference between max and min readings, in:
0° = 0.00000 90° = 0.00020

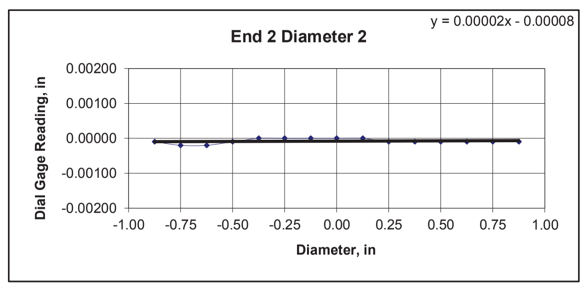
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	-0.00010	-0.00020	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010

Difference between max and min readings, in:
0° = 0.0001 90° = 0.0002
Maximum difference must be < 0.0020 in. Difference = $\pm$ 0.00010
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00000
Angle of Best Fit Line: 0.00000

End 2:
Slope of Best Fit Line 0.00005
Angle of Best Fit Line: 0.00295

Maximum Angular Difference: 0.00295

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00001
Angle of Best Fit Line: 0.00033

End 2:
Slope of Best Fit Line 0.00002
Angle of Best Fit Line: 0.00098

Maximum Angular Difference: 0.00065

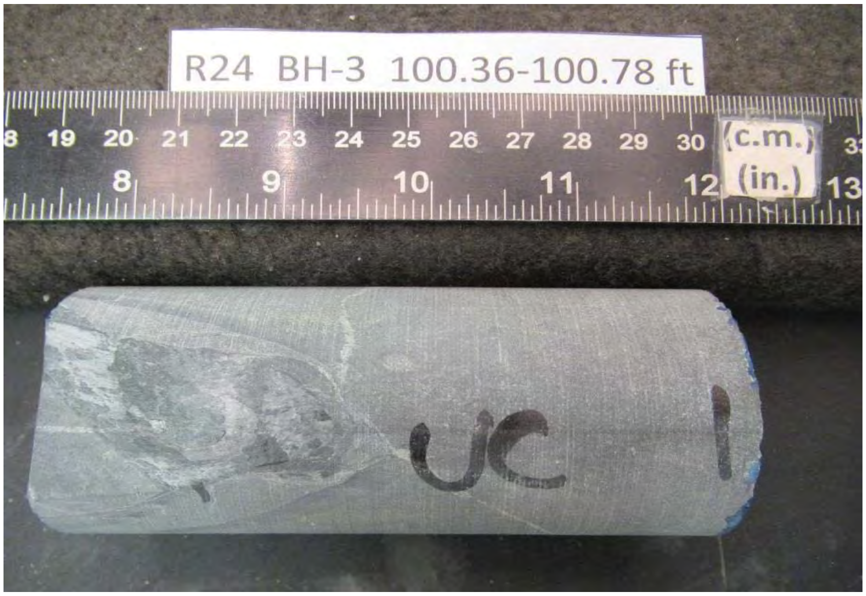
Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00000	1.990	0.00000	0.000	YES
Diameter 2, in (rotated 90°)	0.00020	1.990	0.00010	0.006	YES
END 2					
Diameter 1, in	0.00010	1.990	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00020	1.990	0.00010	0.006	YES

Maximum angle of departure must be $\leq$ 0.25°
Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	12/24/2018
Tested By:	cmh
Checked By:	jsc
Boring ID:	R24
Sample ID:	BH-3
Depth, ft:	100.36-100.78



After cutting and grinding

After break

GeoTesting EXPRESS

Client:	S.W. Cole Engineering, Inc.	Test Date:	12/24/2018
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	R26		
Sample ID:	BH-3		
Depth:	110.25-110.65 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.49	4.49	4.49
Specimen Diameter, in:	1.98	1.98	1.98
Specimen Mass, g:	614.3		
Bulk Density, lb/ft^3	169		
Length to Diameter Ratio:	2.3		

Minimum Diameter Tolerence Met? YES
Length to Diameter Ratio Tolerance Met? YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

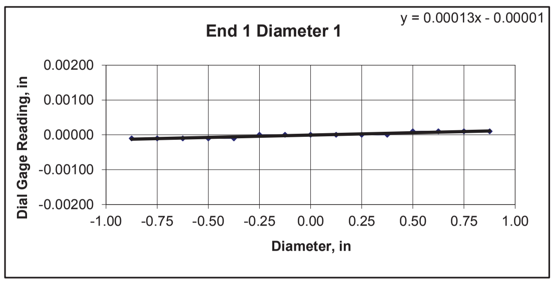
END FLATNESS AND PARALLELISM (Procedure FP1)

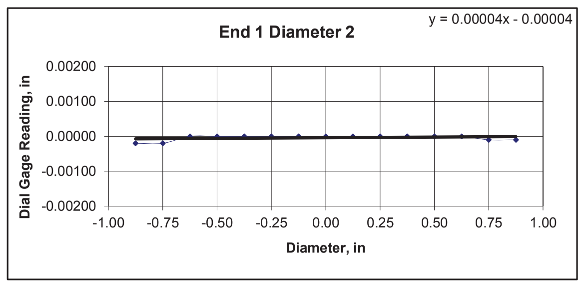
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00010	0.00010
Diameter 2, in (rotated 90°)	-0.00020	-0.00020	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010

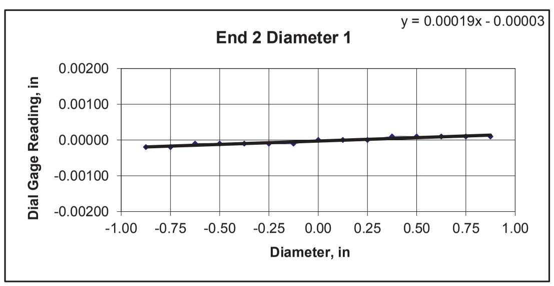
Difference between max and min readings, in:
0° = 0.00020 90° = 0.00020

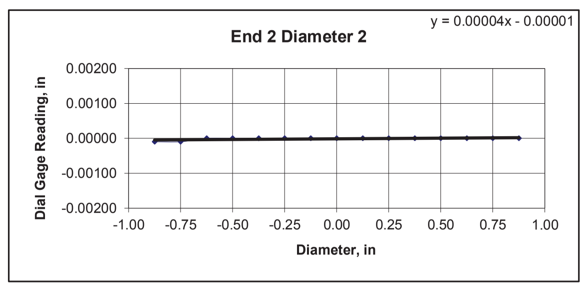
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00020	-0.00020	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00010	0.00010	0.00010	0.00010	0.00010
Diameter 2, in (rotated 90°)	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Difference between max and min readings, in:
0° = 0.0003 90° = 0.0001
Maximum difference must be < 0.0020 in. Difference = ± 0.00015
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00013
Angle of Best Fit Line: 0.00769

End 2:
Slope of Best Fit Line 0.00019
Angle of Best Fit Line: 0.01080

Maximum Angular Difference: 0.00311

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00004
Angle of Best Fit Line: 0.00213

End 2:
Slope of Best Fit Line 0.00004
Angle of Best Fit Line: 0.00213

Maximum Angular Difference: 0.00000

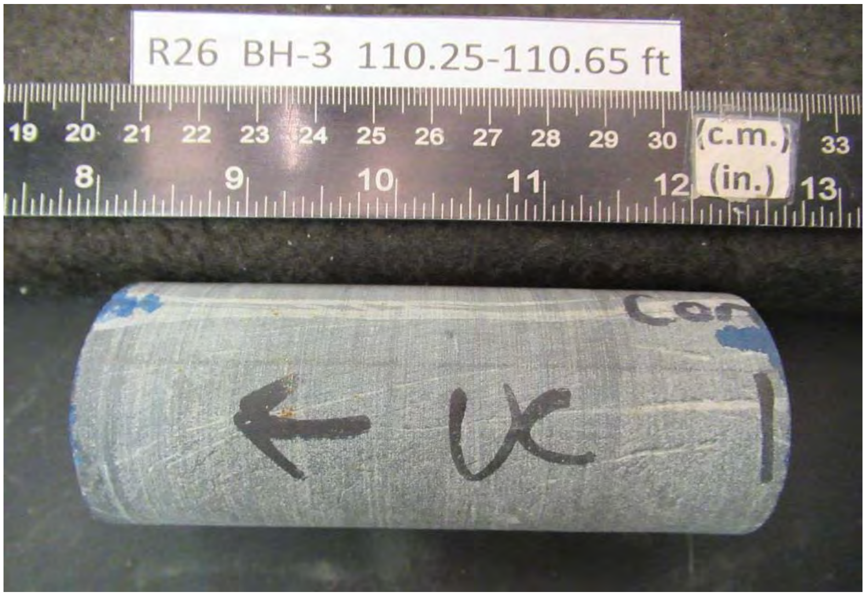
Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00020	1.980	0.00010	0.006	YES
Diameter 2, in (rotated 90°)	0.00020	1.980	0.00010	0.006	YES
END 2					
Diameter 1, in	0.00030	1.980	0.00015	0.009	YES
Diameter 2, in (rotated 90°)	0.00010	1.980	0.00005	0.003	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	12/24/2018
Tested By:	cmh
Checked By:	jsc
Boring ID:	R26
Sample ID:	BH-3
Depth, ft:	110.25-110.65



After cutting and grinding

After break

Client:	S.W. Cole Engineering, Inc.	Test Date:	12/24/2018
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	R37		
Sample ID:	BH-4		
Depth:	46.92-47.33 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.57	4.57	4.57
Specimen Diameter, in:	1.99	1.99	1.99
Specimen Mass, g:	647.19		
Bulk Density, lb/ft^3	174	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap $\leq$ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

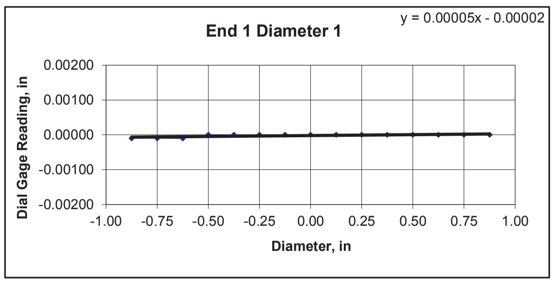
END FLATNESS AND PARALLELISM (Procedure FP1)

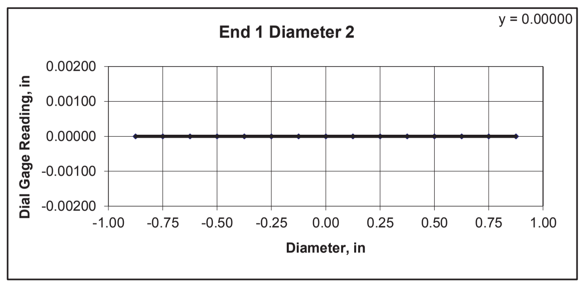
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

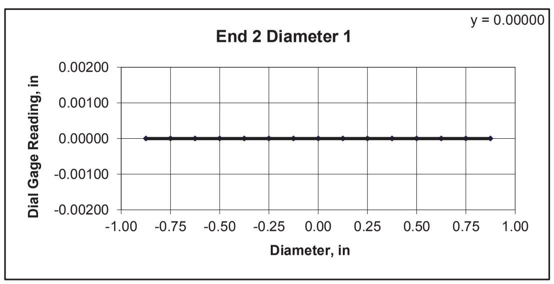
Difference between max and min readings, in:
0° = 0.00010 90° = 0.00000

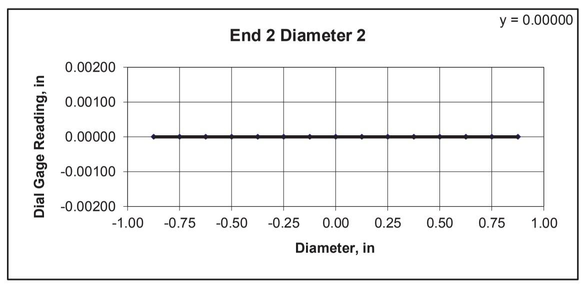
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Difference between max and min readings, in:
0° = 0 90° = 0
Maximum difference must be < 0.0020 in. Difference = $\pm$ 0.00005
Flatness Tolerance Met? YES









DIAMETER 1

End 1:	Slope of Best Fit Line	0.00005
	Angle of Best Fit Line:	0.00295
End 2:	Slope of Best Fit Line	0.00000
	Angle of Best Fit Line:	0.00000
Maximum Angular Difference:		0.00295

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:	Slope of Best Fit Line	0.00000
	Angle of Best Fit Line:	0.00000
End 2:	Slope of Best Fit Line	0.00000
	Angle of Best Fit Line:	0.00000
Maximum Angular Difference:		0.00000

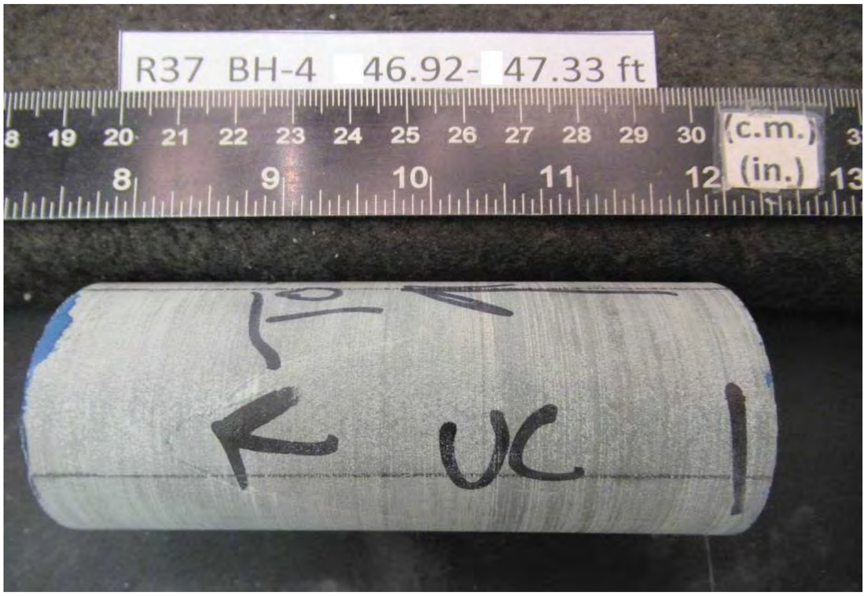
Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00010	1.990	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00000	1.990	0.00000	0.000	YES
END 2					
Diameter 1, in	0.00000	1.990	0.00000	0.000	YES
Diameter 2, in (rotated 90°)	0.00000	1.990	0.00000	0.000	YES

Maximum angle of departure must be $\leq$ 0.25°
Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	12/24/2018
Tested By:	cmh
Checked By:	jsc
Boring ID:	R37
Sample ID:	BH-4
Depth, ft:	46.92-47.33



After cutting and grinding

After break

Client:	S.W. Cole Engineering, Inc.	Test Date:	12/24/2018
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	R40		
Sample ID:	BH-4		
Depth:	160.66-161.06 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.49	4.49	4.49
Specimen Diameter, in:	1.99	1.99	1.99
Specimen Mass, g:	617.49		
Bulk Density, lb/ft^3	168	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

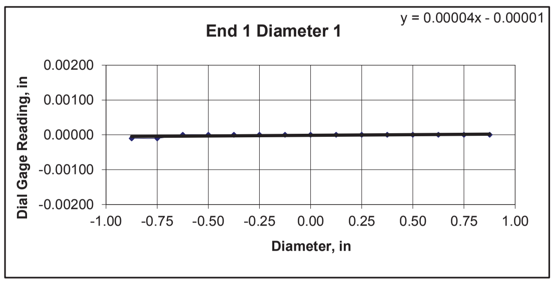
END FLATNESS AND PARALLELISM (Procedure FP1)

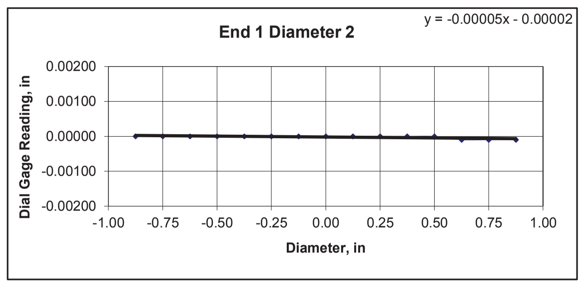
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010

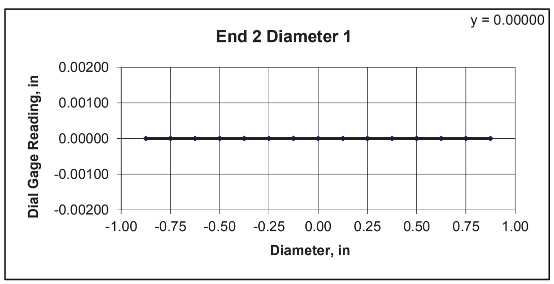
Difference between max and min readings, in:
0° = 0.00010 90° = 0.00010

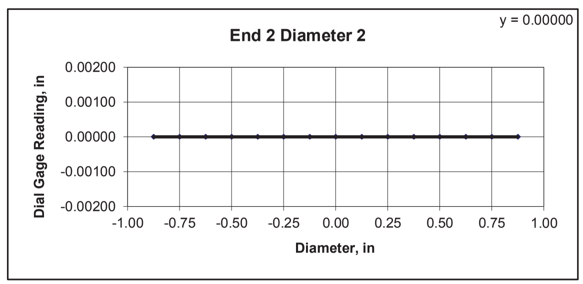
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Difference between max and min readings, in:
0° = 0 90° = 0
Maximum difference must be < 0.0020 in. Difference = ± 0.00005
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00004
Angle of Best Fit Line: 0.00213

End 2:
Slope of Best Fit Line 0.00000
Angle of Best Fit Line: 0.00000

Maximum Angular Difference: 0.00213

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00005
Angle of Best Fit Line: 0.00295

End 2:
Slope of Best Fit Line 0.00000
Angle of Best Fit Line: 0.00000

Maximum Angular Difference: 0.00295

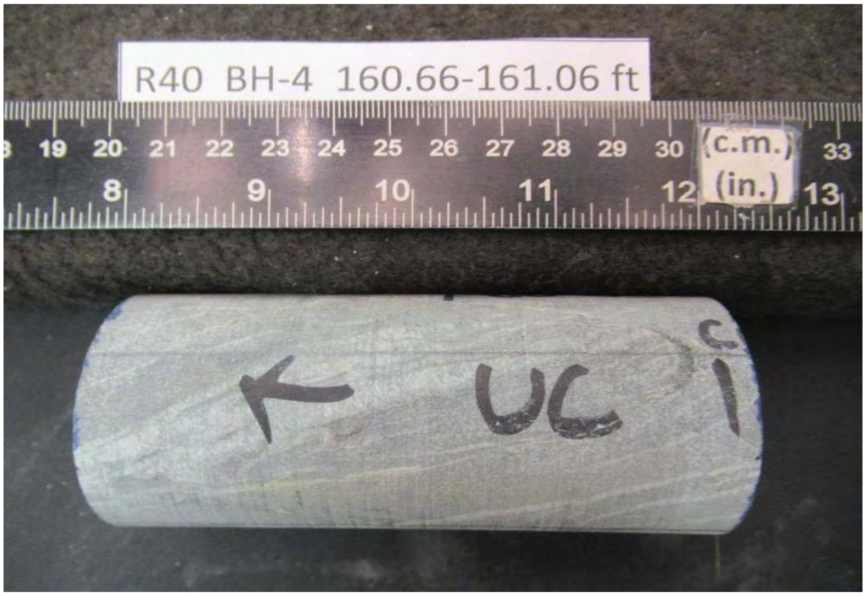
Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

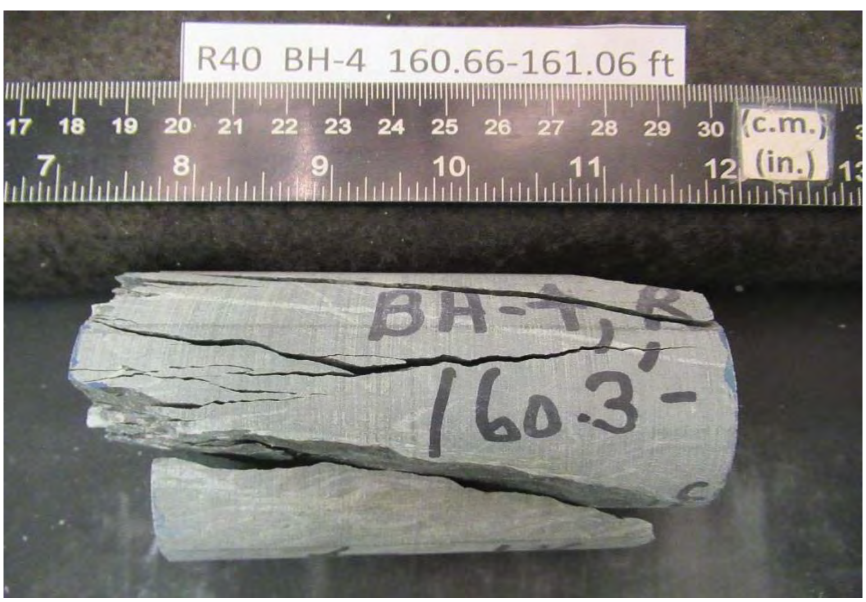
END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00010	1.990	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00010	1.990	0.00005	0.003	YES
END 2					
Diameter 1, in	0.00000	1.990	0.00000	0.000	YES
Diameter 2, in (rotated 90°)	0.00000	1.990	0.00000	0.000	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	12/24/2018
Tested By:	cmh
Checked By:	jsc
Boring ID:	R40
Sample ID:	BH-4
Depth, ft:	160.66-161.06



After cutting and grinding



After break

Client:	S.W. Cole Engineering, Inc.	Test Date:	12/24/2018
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	R43		
Sample ID:	BH-4		
Depth:	174.99-175.38 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average		
Specimen Length, in:	4.40	4.40	4.40		
Specimen Diameter, in:	1.99	1.99	1.99		
Specimen Mass, g:	609.4				
Bulk Density, lb/ft^3	169			**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.2			**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap $\leq$ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

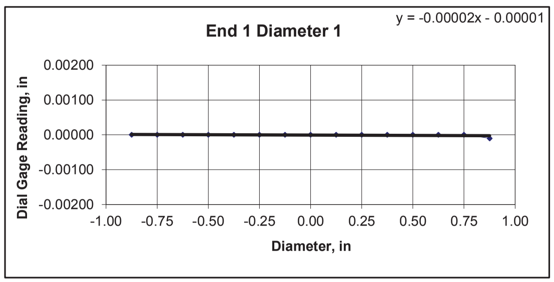
END FLATNESS AND PARALLELISM (Procedure FP1)

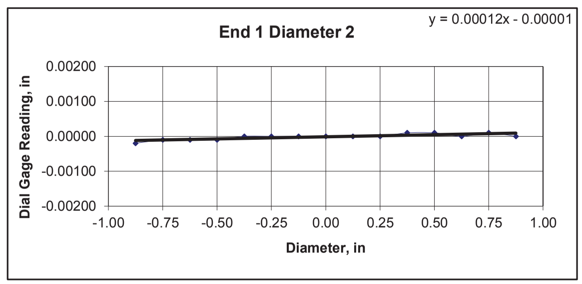
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010
Diameter 2, in (rotated 90°)	-0.00020	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00000	0.00010	0.00000

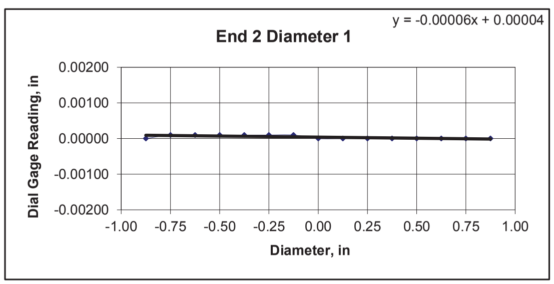
Difference between max and min readings, in:
0° = 0.00010 90° = 0.00030

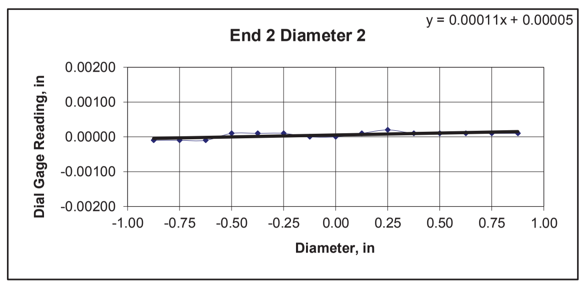
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	-0.00010	-0.00010	-0.00010	0.00010	0.00010	0.00010	0.00000	0.00000	0.00010	0.00020	0.00010	0.00010	0.00010	0.00010	0.00010

Difference between max and min readings, in:
0° = 0.0001 90° = 0.0003
Maximum difference must be < 0.0020 in. Difference = $\pm$ 0.00015
Flatness Tolerance Met? YES









DIAMETER 1

End 1:	Slope of Best Fit Line	0.00002
	Angle of Best Fit Line:	0.00115
End 2:	Slope of Best Fit Line	0.00006
	Angle of Best Fit Line:	0.00344
Maximum Angular Difference:		0.00229

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:	Slope of Best Fit Line	0.00012
	Angle of Best Fit Line:	0.00688
End 2:	Slope of Best Fit Line	0.00011
	Angle of Best Fit Line:	0.00638
Maximum Angular Difference:		0.00049

Parallelism Tolerance Met? YES
Spherically Seated

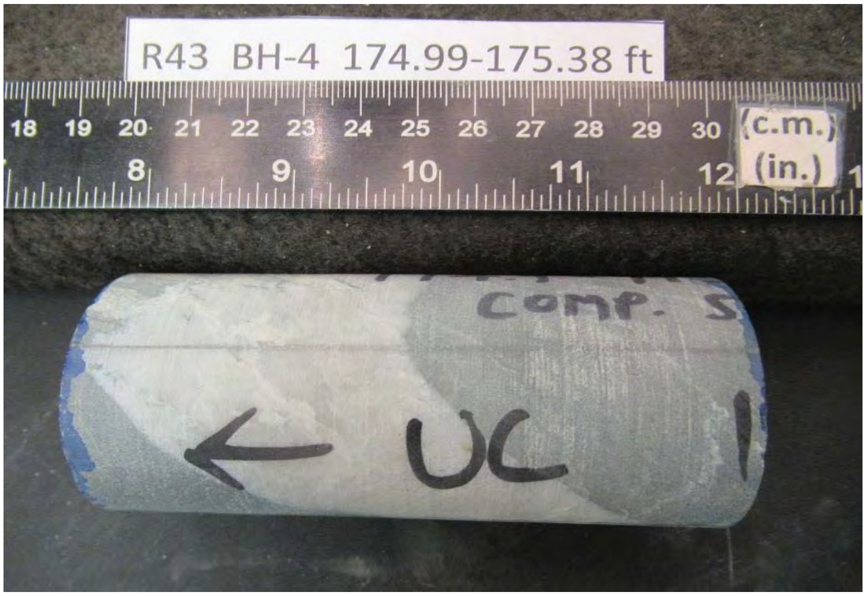
PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

Maximum angle of departure must be $\leq$ 0.25°

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00010	1.990	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00030	1.990	0.00015	0.009	YES
END 2					
Diameter 1, in	0.00010	1.990	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00030	1.990	0.00015	0.009	YES

Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	12/24/2018
Tested By:	cmh
Checked By:	jsc
Boring ID:	R43
Sample ID:	BH-4
Depth, ft:	174.99-175.38



After cutting and grinding

After break

GeoTesting EXPRESS

ROCK CHAIN OF CUSTODY & TEST REQUEST

Attn: John Campbell

GeoTesting Express, Inc.
125 Nagog Park
Acton, MA 01720
800 434 1062 Toll Free
978 635 0266 Fax

~~2358 Perimeter Park Drive, Suite 320~~
~~Atlanta, GA 30341~~
~~770 645 6575 Tel~~
~~770 645 6570 Fax~~

www.geotesting.com

CLIENT		INVOICE (complete if different from Client)	
Company: S W Cole Engineering, Inc		Company:	
Address: 286 Portland Rd		Address:	
City, State, Zip: Gray Me 04039		City, State, Zip:	
Contact: PAUL KOHLER	Phone: 207-517-4867	Contact:	Phone:
E-mail: pkohler@swcole.com	Cell: 207-615-2760	E-mail:	Cell:

PROJECT		
Project Name: NECEC / KRC	Client Project #: 18-0345	Purchase Order#:
Project Location: MAINE	GTX Sales Order #:	Requested Turnaround:
On-site Contact: PAUL KOHLER	E-mail: pkohler@swcole.com	Phone: 207-517-4867

ROCK

Core Run #	Sample ID	Depth (ft)	CERCHAR Abrasivity (ASTM D 7625)* 55HRC/40HRC	Direct Shear (ASTM D5607)*	Direct Tensile Strength (ASTM D 2936)	Elastic Moduli in Triaxial Compression (ASTM D 7012B)	Elastic Moduli in Unlaxial Compression (ASTM D 7012D)	Unit Weight (ISRM)	Petrographic Analysis (ISRM)	Point Load Index (ASTM D 5731)* Diametral, Axial, Lump/Block	Punch Penetration (Handewith)	Slake Durability (ASTM D 4644)	Splitting (Brazilian) Tensile Strength (ASTM D 3967)	Schmidt Hammer (ASTM D 5873)	Total Hardness (Schmidt Hammer and Taber Abrasion)	Triaxial Compression (ASTM D 7012A)	Unconfined Compression (ASTM D 7012C) $230	Other:	Other:
R5	BH-1	19.1-20.5						✓									✓		
R9	BH-2	46.1-47.4						✓									✓		
R11	BH-2	54.5-55.8						✓									✓		
R14	BH-2	69.9-70.8						✓									✓		
R19	BH-3	79.2-81.0						✓									✓		
R21	BH-3	90.3-91.2						✓									✓		
R24	BH-3	100-101.1						✓									✓		
R26	BH-3	110-111.3						✓									✓		
R37	BH-4	46.8-48.5						✓									✓		
R40	BH-4	160.3-161.6						✓									✓		
R43	BH-4	174.9-175.7						✓									✓		

*Specify Test Conditions (Undisturbed or Remolded, Density and Moisture, Test Normal Loads, Test Confining Stresses, etc.):

AUTHORIZE BY SIGNING AND DATING:

SIGNATURE: Paul F Kohler PRINT NAME: PAUL F. KOHLER DATE: 12/5/18

For GTX Use Only
Incoming Sample Inspection Performed ☐
Adverse conditions:

Relinquished By: PAUL KOHLER	DATE: 12-6-18 TIME: 10:09am	Received By: [signature]	DATE: 12/7/18 TIME:
Relinquished By:	DATE: TIME:	Received By:	DATE: TIME:

WARRANTY and LIABILITY

GeoTesting Express (GTX) warrants that all tests it performs are run in general accordance with the specified test procedures and accepted industry practice. GTX will correct or repeat any test that does not comply with this warranty. GTX has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

GTX may report engineering parameters that require us to interpret the test data. Such parameters are determined using accepted engineering procedures. However, GTX does not warrant that these parameters accurately reflect the true engineering properties of the *in situ* material. Responsibility for interpretation and use of the test data and these parameters for engineering and/or construction purposes rests solely with the user and not with GTX or any of its employees.

GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any lost benefits or other consequential damages resulting from the use of these test results, even if GTX has been advised of the possibility of such damages. GTX will not be responsible for any liability of the Purchaser to any third party.

Commonly Used Symbols

A	pore pressure parameter for $\Delta\sigma_1 - \Delta\sigma_3$
B	pore pressure parameter for $\Delta\sigma_3$
CAI	CERCHAR Abrasiveness Index
CIU	isotropically consolidated undrained triaxial shear test
CR	compression ratio for one dimensional consolidation
CSR	cyclic stress ratio
C_c	coefficient of curvature, $(D_{30})^2 / (D_{10} \times D_{60})$
C_u	coefficient of uniformity, D_{60}/D_{10}
C_c	compression index for one dimensional consolidation
C_α	coefficient of secondary compression
c_v	coefficient of consolidation
c	cohesion intercept for total stresses
c'	cohesion intercept for effective stresses
D	diameter of specimen
D	damping ratio
D_{10}	diameter at which 10% of soil is finer
D_{15}	diameter at which 15% of soil is finer
D_{30}	diameter at which 30% of soil is finer
D_{50}	diameter at which 50% of soil is finer
D_{60}	diameter at which 60% of soil is finer
D_{85}	diameter at which 85% of soil is finer
d_{50}	displacement for 50% consolidation
d_{90}	displacement for 90% consolidation
d_{100}	displacement for 100% consolidation
E	Young's modulus
e	void ratio
e_c	void ratio after consolidation
e_o	initial void ratio
G	shear modulus
G_s	specific gravity of soil particles
H	height of specimen
H_R	Rebound Hardness number
i	gradient
I_S	Uncorrected point load strength
$I_{S(50)}$	Size corrected point load strength index
H_A	Modified Taber Abrasion
H_T	Total hardness
K_o	lateral stress ratio for one dimensional strain
k	permeability
LI	Liquidity Index
m_v	coefficient of volume change
n	porosity
PI	plasticity index
P_c	preconsolidation pressure
p	$(\sigma_1 + \sigma_3) / 2$, $(\sigma_v + \sigma_h) / 2$
p'	$(\sigma'_1 + \sigma'_3) / 2$, $(\sigma'_v + \sigma'_h) / 2$
p'_c	p' at consolidation
Q	quantity of flow
q	$(\sigma_1 - \sigma_3) / 2$
q_f	q at failure
q_o, q_i	initial q
q_c	q at consolidation
S_r	Post cyclic undrained shear strength
T	temperature
t	time
U, UC	unconfined compression test
UU, Q	unconsolidated undrained triaxial test
u_a	pore gas pressure
u_e	excess pore water pressure
u, u_w	pore water pressure
V	total volume
V_g	volume of gas
V_s	volume of solids
V_s	shear wave velocity
V_v	volume of voids
V_w	volume of water
V_o	initial volume
v	velocity
W	total weight
W_s	weight of solids
W_w	weight of water
w	water content
w_c	water content at consolidation
w_f	final water content
w_l	liquid limit
w_n	natural water content
w_p	plastic limit
w_s	shrinkage limit
w_o, w_i	initial water content
α	slope of q_f versus p_f
α'	slope of q_f versus p_f'
γ_t	total unit weight
γ_d	dry unit weight
γ_s	unit weight of solids
γ_w	unit weight of water
ε	strain
ε_{vol}	volume strain
ε_h, ε_v	horizontal strain, vertical strain
μ	Poisson's ratio, also viscosity
σ	normal stress
σ'	effective normal stress
σ_c, σ'_c	consolidation stress in isotropic stress system
σ_h, σ'_h	horizontal normal stress
σ_v, σ'_v	vertical normal stress
σ'_{vc}	Effective vertical consolidation stress
σ_1	major principal stress
σ_2	intermediate principal stress
σ_3	minor principal stress
τ	shear stress
φ	friction angle based on total stresses
φ'	friction angle based on effective stresses
φ'_r	residual friction angle
φ_{ult}	φ for ultimate strength

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Transmittal

TO:

Paul Kohler
S.W. Cole Engineering, Inc.
286 Portland Road
Gray, ME 04039-9586

DATE: 3/21/2019	GTX NO: 309265
RE: NECEC/KRC	

COPIES	DATE	DESCRIPTION
	3/21/2019	**March 2019 Laboratory Test Report**

REMARKS:

SIGNED: Jon Campbell

Jonathan Campbell, Assistant Laboratory Manager

CC:

APPROVED BY: Mark Dobday

Mark Dobday, P.G., Laboratory Manager

March 21, 2019

Paul Kohler
S.W. Cole Engineering, Inc.
286 Portland Road
Gray, ME 04039-9586

RE: NECEC/KRC, Maine (GTX-309265)

Dear Paul:

Enclosed are the test results you requested for the above referenced project. GeoTesting Express, Inc. (GTX) received nine samples from you on 2/12/2019. These samples were labeled as follows:

Boring Number	Sample Number	Depth
BH-2	R16	75-80 ft
BH-2	R18	85-90 ft
BH-3	R17	67.7-71.5 ft
BH-3	R23 / R24	92.1-100.0 ft
BH-3	R25	101.5-106.5 ft
BH-4	R21	74.6-79.6 ft
BH-4	R40 / R41	160-166.6 ft
BH-4	R42	167-177.5 ft
BH-4	R44	176.6-181.6 ft

GTX performed the following tests on these samples:

4 ASTM D4644 - Slake Durability
7 ASTM D7012 Method C- Uniaxial Compressive Strength of Rock
7 ASTM D7625 -CERCHAR Abrasivity Index (CAI)
2 NTNU 13A-98 - Drillability Test Suite

GTX also subcontracted with Spectrum Petrographics of Vancouver, WA to perform a Petrographic Analysis (thin section) on seven of your samples. We will forward you the results of these analyses as soon as the Spectrum reports are received.

A copy of your test request is attached.

The results presented in this report apply only to the items tested. This report shall not be reproduced except in full, without written approval from GeoTesting Express. The remainder of these samples will be retained for a period of sixty (60) days and will then be discarded unless otherwise notified by you. Please call me if you have any questions or require additional information. Thank you for allowing GeoTesting Express the opportunity of providing you with testing services. We look forward to working with you again in the future.

Respectfully yours,

Jonathan Campbell
Assistant Laboratory Manager

GeoTesting
EXPRESS

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Geotechnical Test Report **3/21/2019**

GTX-309265

NECEC/KRC

Maine

Client Project No.: 18-0345

Prepared for:

S.W. Cole Engineering, Inc.

Client:	S.W. Cole Engineering, Inc.		
Project:	NECEC/KRC		
Location:	Maine	Project No:	GTX-309265
Boring ID: ---	Sample Type: ---	Tested By:	smd
Sample ID: ---	Test Date: 02/22/19	Checked By:	jsc
Depth : ---	Test Id: 495067		

Bulk Density and Compressive Strength of Rock Core Specimens by ASTM D7012 Method C

Boring ID	Sample Number	Depth	Bulk Density, pcf	Compressive strength, psi	Failure Type	Meets ASTM D4543	Note(s)
BH-2	R16	75 - 80 ft	169	3536	1	Yes	---
BH-2	R18	85 - 90 ft	170	4755	1	Yes	---
BH-3	R17	67.7 - 71.5 ft	167	18526	1	Yes	---
BH-3	R24	96.5 - 98.5 ft	169	16264	1	Yes	---
BH-4	R21	74.6 - 79.6 ft	177	5811	1	Yes	---
BH-4	R42	167 - 177.5 ft	168	8267	1	Yes	---
BH-4	R44	176.6 - 181.6 ft	168	5951	1	Yes	---

Notes: Density determined on core samples by measuring dimensions and weight and then calculating.

All specimens tested at the approximate as-received moisture content and at standard laboratory temperature.

The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.

Failure Type: 1 = Intact Material Failure; 2 = Discontinuity Failure; 3 = Intact Material and Discontinuity Failure (See attached photographs)

Client:	S.W. Cole Engineering, Inc.	Test Date:	2/22/2019
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	BH-2		
Sample ID:	R16		
Depth:	75-80 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.16	4.16	4.16
Specimen Diameter, in:	2.00	1.99	2.00
Specimen Mass, g:	578.59		
Bulk Density, lb/ft^3	169	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.1	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.

Straightness Tolerance Met? YES

END FLATNESS AND PARALLELISM (Procedure FP1)

END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diameter 2, in (rotated 90°)	-0.00060	-0.00060	-0.00050	-0.00040	-0.00040	-0.00040	-0.00020	0.00000	0.00010	0.00010	0.00020	0.00040	0.00050	0.00060	0.00060

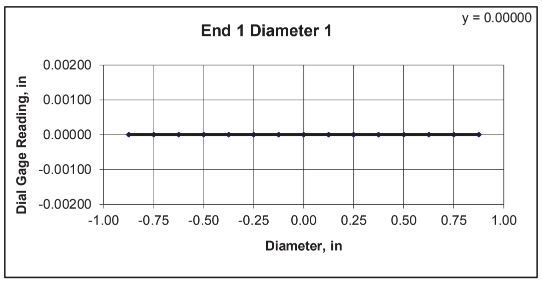
Difference between max and min readings, in:
0° = 0.00000 90° = 0.00120

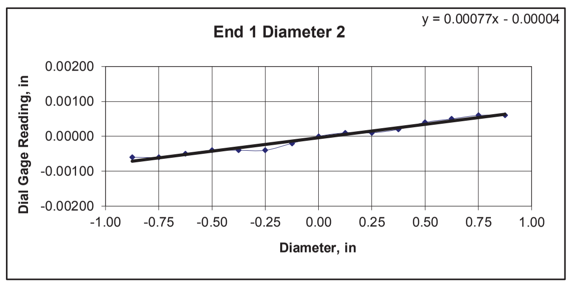
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010
Diameter 2, in (rotated 90°)	-0.00090	-0.00090	-0.00080	-0.00070	-0.00050	-0.00040	-0.00040	0.00000	0.00010	0.00020	0.00020	0.00020	0.00020	0.00030	0.00050

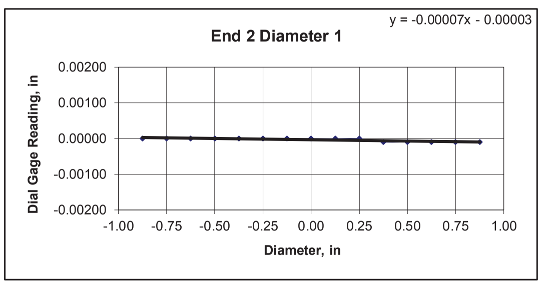
Difference between max and min readings, in:
0° = 0.0001 90° = 0.0014

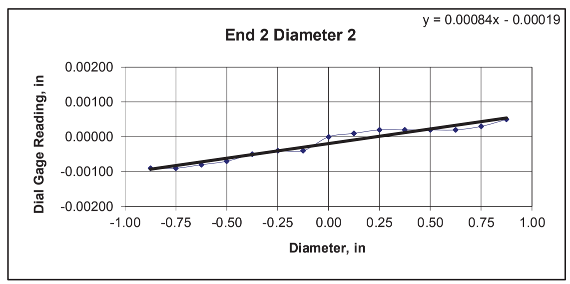
Maximum difference must be < 0.0020 in. Difference = ± 0.00070

Flatness Tolerance Met? YES









DIAMETER 1

End 1:	Slope of Best Fit Line	0.00000
	Angle of Best Fit Line:	0.00000
End 2:	Slope of Best Fit Line	0.00007
	Angle of Best Fit Line:	0.00409
Maximum Angular Difference:		0.00409

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:	Slope of Best Fit Line	0.00077
	Angle of Best Fit Line:	0.04404
End 2:	Slope of Best Fit Line	0.00084
	Angle of Best Fit Line:	0.04813
Maximum Angular Difference:		0.00409

Parallelism Tolerance Met? YES
Spherically Seated

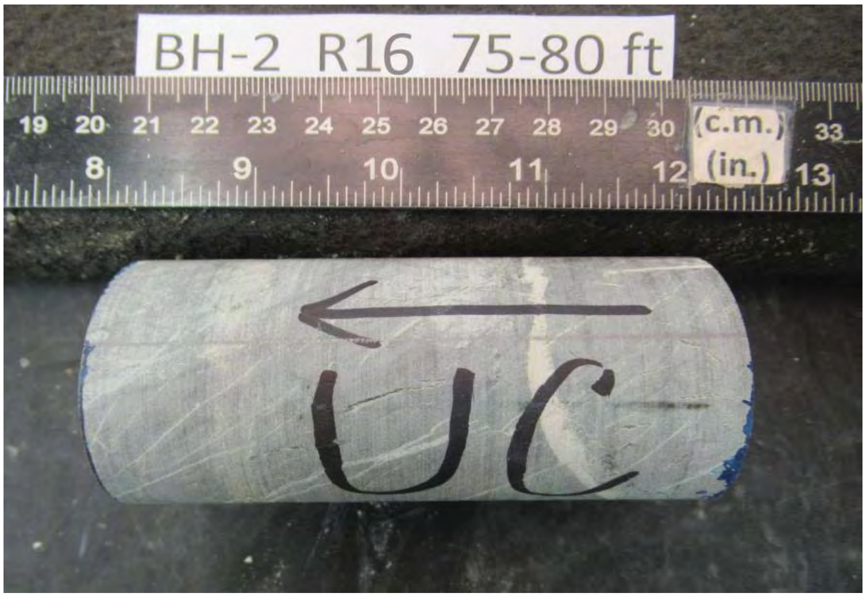
PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00000	1.995	0.00000	0.000	YES
Diameter 2, in (rotated 90°)	0.00120	1.995	0.00060	0.034	YES
END 2					
Diameter 1, in	0.00010	1.995	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00140	1.995	0.00070	0.040	YES

Maximum angle of departure must be ≤ 0.25°

Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	2/22/2019
Tested By:	cmh
Checked By:	jsc
Boring ID:	BH-2
Sample ID:	R16
Depth, ft:	75-80



After cutting and grinding

After break

GeoTesting EXPRESS

Client:	S.W. Cole Engineering, Inc.	Test Date:	2/22/2019
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	BH-2		
Sample ID:	R18		
Depth:	85-90 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.40	4.40	4.40
Specimen Diameter, in:	1.99	1.99	1.99
Specimen Mass, g:	613.59		
Bulk Density, lb/ft^3	170	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.2	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

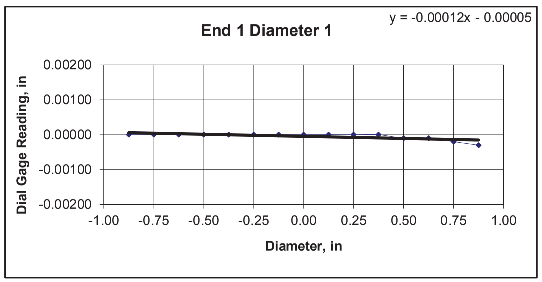
END FLATNESS AND PARALLELISM (Procedure FP1)

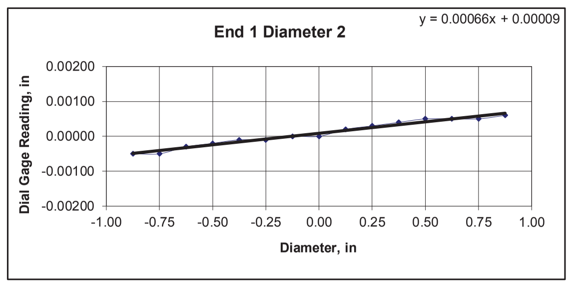
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020	-0.00030
Diameter 2, in (rotated 90°)	-0.00050	-0.00050	-0.00030	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00020	0.00030	0.00040	0.00050	0.00050	0.00050	0.00060

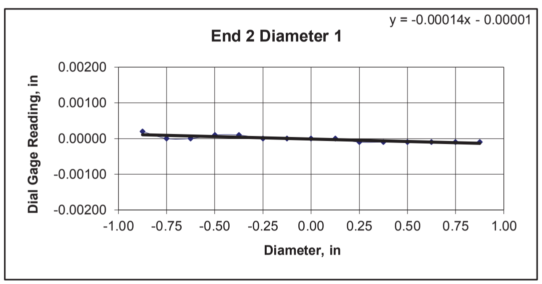
Difference between max and min readings, in:
0° = 0.00030 90° = 0.00110

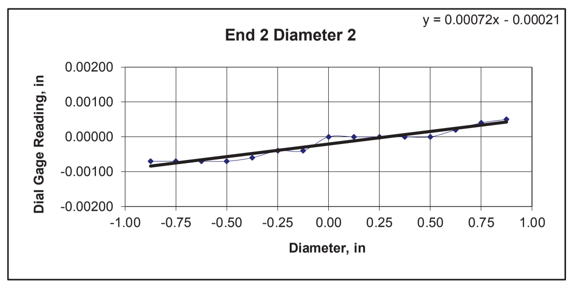
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00020	0.00000	0.00000	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010
Diameter 2, in (rotated 90°)	-0.00070	-0.00070	-0.00070	-0.00070	-0.00060	-0.00040	-0.00040	0.00000	0.00000	0.00000	0.00000	0.00000	0.00020	0.00040	0.00050

Difference between max and min readings, in:
0° = 0.0003 90° = 0.0012
Maximum difference must be < 0.0020 in. Difference = ± 0.00060
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00012
Angle of Best Fit Line: 0.00688

End 2:
Slope of Best Fit Line 0.00014
Angle of Best Fit Line: 0.00786

Maximum Angular Difference: 0.00098

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00066
Angle of Best Fit Line: 0.03765

End 2:
Slope of Best Fit Line 0.00072
Angle of Best Fit Line: 0.04142

Maximum Angular Difference: 0.00377

Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1)

(Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00030	1.990	0.00015	0.009	YES
Diameter 2, in (rotated 90°)	0.00110	1.990	0.00055	0.032	YES
END 2					
Diameter 1, in	0.00030	1.990	0.00015	0.009	YES
Diameter 2, in (rotated 90°)	0.00120	1.990	0.00060	0.035	YES

Maximum angle of departure must be ≤ 0.25°

Perpendicularity Tolerance Met? YES

GeoTesting EXPRESS

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	2/22/2019
Tested By:	cmh
Checked By:	jsc
Boring ID:	BH-2
Sample ID:	R18
Depth, ft:	85-90

After cutting and grinding

After break

GeoTesting EXPRESS

Client:	S.W. Cole Engineering, Inc.	Test Date:	2/22/2019
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	BH-3		
Sample ID:	R17		
Depth:	67.7-71.5 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.49	4.48	4.49
Specimen Diameter, in:	1.99	2.00	2.00
Specimen Mass, g:	616.76		
Bulk Density, lb/ft^3	167		
Length to Diameter Ratio:	2.2		

Minimum Diameter Tolerence Met? YES
Length to Diameter Ratio Tolerance Met? YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

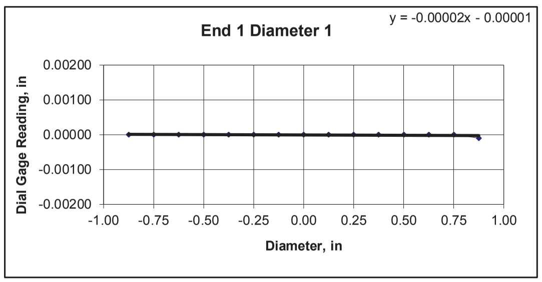
END FLATNESS AND PARALLELISM (Procedure FP1)

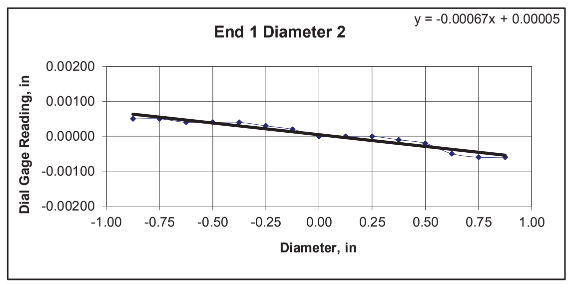
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010
Diameter 2, in (rotated 90°)	0.00050	0.00050	0.00040	0.00040	0.00040	0.00030	0.00020	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00050	-0.00060	-0.00060

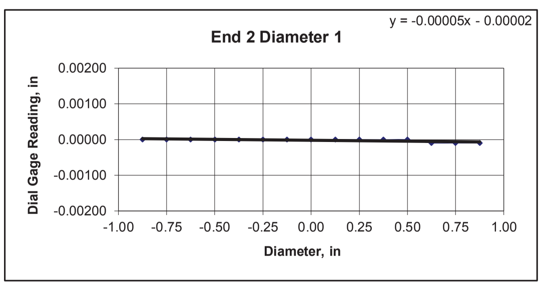
Difference between max and min readings, in:
0° = 0.00010 90° = 0.00110

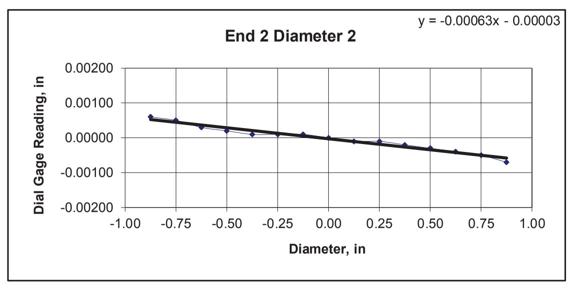
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010
Diameter 2, in (rotated 90°)	0.00060	0.00050	0.00030	0.00020	0.00010	0.00010	0.00010	0.00000	-0.00010	-0.00010	-0.00020	-0.00030	-0.00040	-0.00050	-0.00070

Difference between max and min readings, in:
0° = 0.0001 90° = 0.0013
Maximum difference must be < 0.0020 in. Difference = ± 0.00065
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00002
Angle of Best Fit Line: 0.00115

End 2:
Slope of Best Fit Line 0.00005
Angle of Best Fit Line: 0.00295

Maximum Angular Difference: 0.00180

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00067
Angle of Best Fit Line: 0.03847

End 2:
Slope of Best Fit Line 0.00063
Angle of Best Fit Line: 0.03618

Maximum Angular Difference: 0.00229

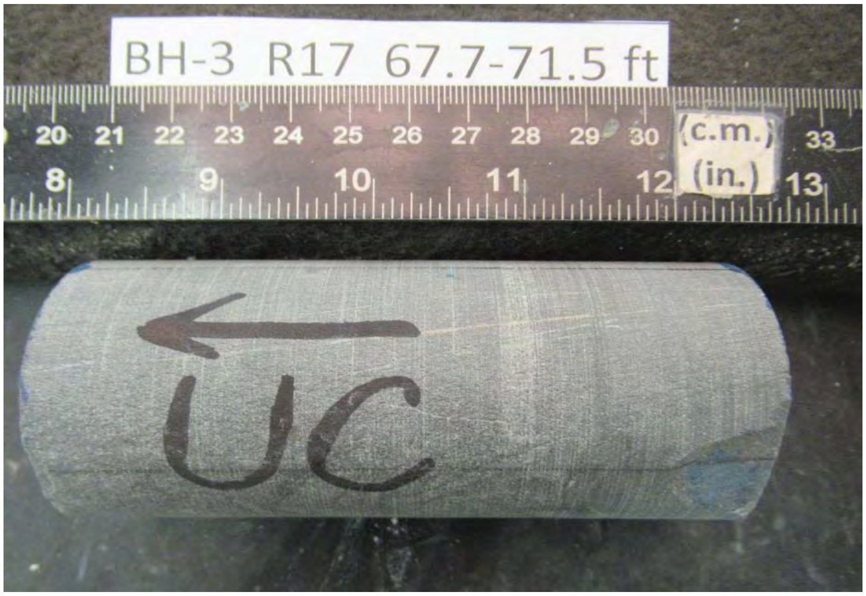
Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00010	1.995	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00110	1.995	0.00055	0.032	YES
END 2					
Diameter 1, in	0.00010	1.995	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00130	1.995	0.00065	0.037	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	2/22/2019
Tested By:	cmh
Checked By:	jsc
Boring ID:	BH-3
Sample ID:	R17
Depth, ft:	67.7-71.5



After cutting and grinding

After break

GeoTesting EXPRESS

Client:	S.W. Cole Engineering, Inc.	Test Date:	2/22/2019
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	BH-3		
Sample ID:	R24		
Depth:	96.5-98.5 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.51	4.51	4.51
Specimen Diameter, in:	1.99	1.99	1.99
Specimen Mass, g:	624.08		
Bulk Density, lb/ft^3	169	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap $\leq$ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

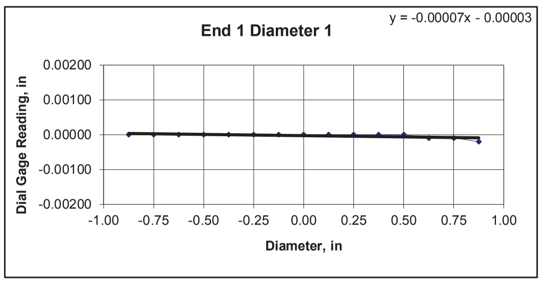
END FLATNESS AND PARALLELISM (Procedure FP1)

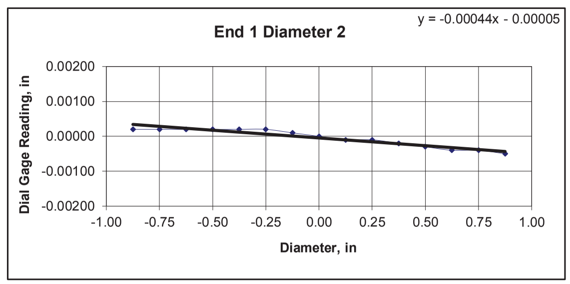
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020
Diameter 2, in (rotated 90°)	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00010	0.00000	-0.00010	-0.00010	-0.00020	-0.00030	-0.00040	-0.00040	-0.00050

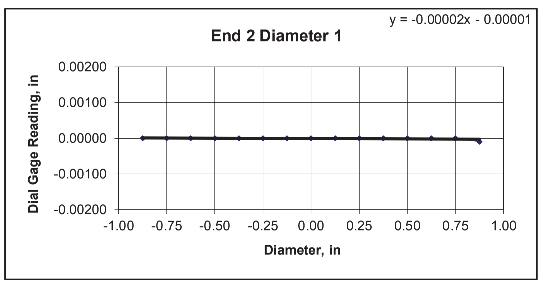
Difference between max and min readings, in:
0° = 0.00020 90° = 0.00070

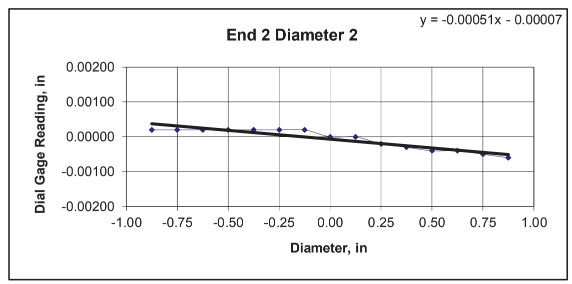
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010
Diameter 2, in (rotated 90°)	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00000	0.00000	-0.00020	-0.00030	-0.00040	-0.00040	-0.00050	-0.00060

Difference between max and min readings, in:
0° = 0.0001 90° = 0.0008
Maximum difference must be < 0.0020 in. Difference = $\pm$ 0.00040
Flatness Tolerance Met? YES









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00007
Angle of Best Fit Line: 0.00409

End 2:
Slope of Best Fit Line 0.00002
Angle of Best Fit Line: 0.00115

Maximum Angular Difference: 0.00295

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00044
Angle of Best Fit Line: 0.02537

End 2:
Slope of Best Fit Line 0.00051
Angle of Best Fit Line: 0.02898

Maximum Angular Difference: 0.00360

Parallelism Tolerance Met? YES
Spherically Seated

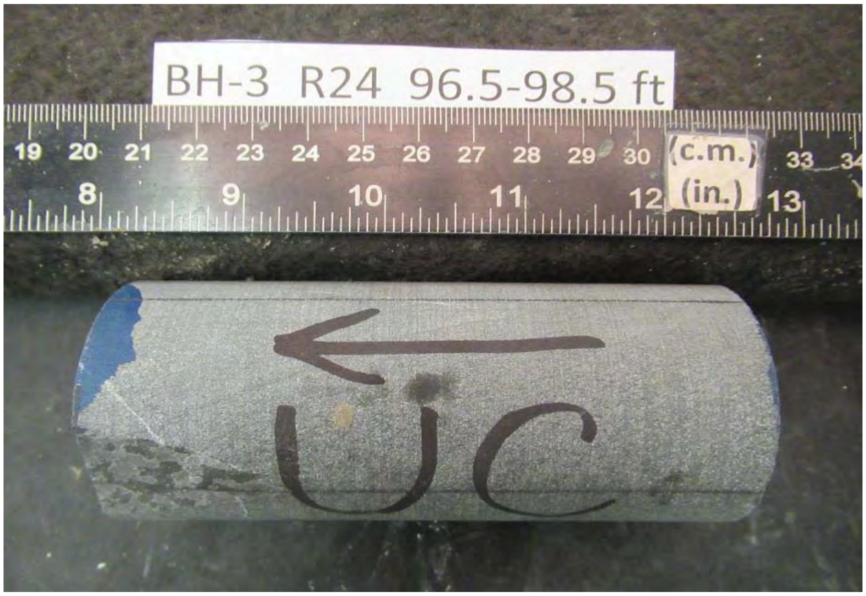
PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00020	1.990	0.00010	0.006	YES
Diameter 2, in (rotated 90°)	0.00070	1.990	0.00035	0.020	YES
END 2					
Diameter 1, in	0.00010	1.990	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00080	1.990	0.00040	0.023	YES

Maximum angle of departure must be $\leq$ 0.25°

Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	2/22/2019
Tested By:	cmh
Checked By:	jsc
Boring ID:	BH-3
Sample ID:	R24
Depth, ft:	96.5-98.5



After cutting and grinding

After break

GeoTesting EXPRESS

Client:	S.W. Cole Engineering, Inc.	Test Date:	2/22/2019
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	BH-4		
Sample ID:	R21		
Depth:	74.6-79.6 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.44	4.44	4.44
Specimen Diameter, in:	1.99	1.99	1.99
Specimen Mass, g:	643.57		
Bulk Density, lb/ft^3	177		
Length to Diameter Ratio:	2.2		

Minimum Diameter Tolerence Met? YES
Length to Diameter Ratio Tolerance Met? YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap $\leq$ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

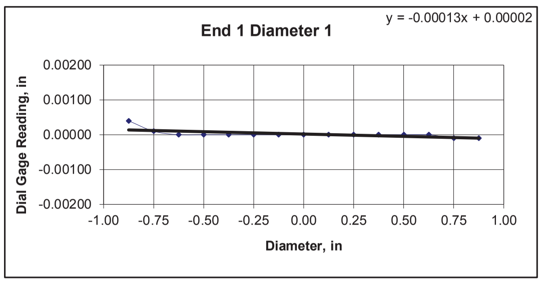
END FLATNESS AND PARALLELISM (Procedure FP1)

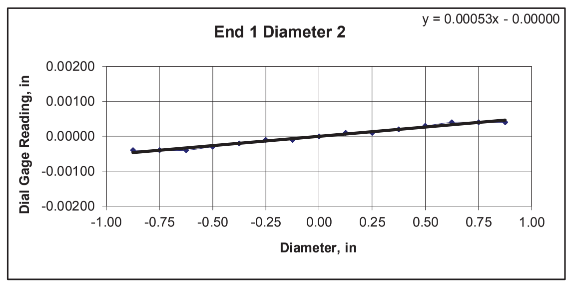
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00040	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010
Diameter 2, in (rotated 90°)	-0.00040	-0.00040	-0.00040	-0.00030	-0.00020	-0.00010	-0.00010	0.00000	0.00010	0.00010	0.00020	0.00030	0.00040	0.00040	0.00040

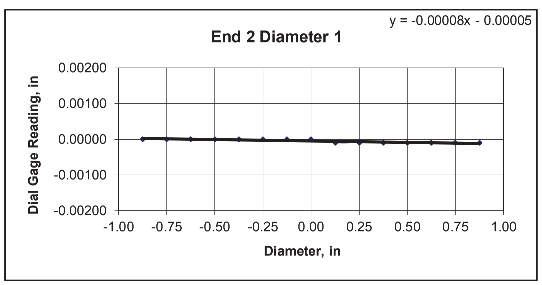
Difference between max and min readings, in:
0° = 0.00050 90° = 0.00080

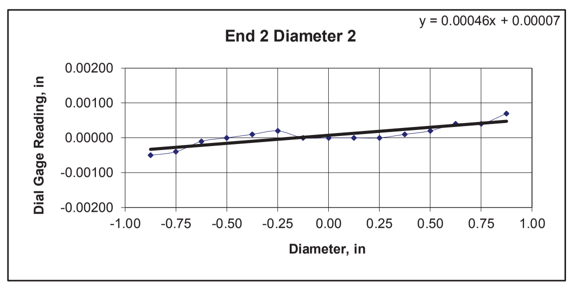
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010
Diameter 2, in (rotated 90°)	-0.00050	-0.00040	-0.00010	0.00000	0.00010	0.00020	0.00000	0.00000	0.00000	0.00000	0.00010	0.00020	0.00040	0.00040	0.00070

Difference between max and min readings, in:
0° = 0.0001 90° = 0.0012
Maximum difference must be < 0.0020 in. Difference = $\pm$ 0.00060
Flatness Tolerance Met? YES









DIAMETER 1

End 1:	Slope of Best Fit Line	0.00013
	Angle of Best Fit Line:	0.00769
End 2:	Slope of Best Fit Line	0.00008
	Angle of Best Fit Line:	0.00458
Maximum Angular Difference:		0.00311

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:	Slope of Best Fit Line	0.00053
	Angle of Best Fit Line:	0.03045
End 2:	Slope of Best Fit Line	0.00046
	Angle of Best Fit Line:	0.02636
Maximum Angular Difference:		0.00409

Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00050	1.990	0.00025	0.014	YES
Diameter 2, in (rotated 90°)	0.00080	1.990	0.00040	0.023	YES
END 2					
Diameter 1, in	0.00010	1.990	0.00005	0.003	YES
Diameter 2, in (rotated 90°)	0.00120	1.990	0.00060	0.035	YES

Maximum angle of departure must be $\leq$ 0.25°

Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	2/22/2019
Tested By:	cmh
Checked By:	jsc
Boring ID:	BH-4
Sample ID:	R21
Depth, ft:	74.6-79.6

After cutting and grinding

After break

GeoTesting EXPRESS

Client:	S.W. Cole Engineering, Inc.	Test Date:	2/22/2019
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	BH-4		
Sample ID:	R42		
Depth:	167-177.5 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.56	4.56	4.56
Specimen Diameter, in:	1.98	1.99	1.99
Specimen Mass, g:	625.25		
Bulk Density, lb/ft^3	168	**Minimum Diameter Tolerence Met?**	YES
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	YES

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap $\leq$ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? YES

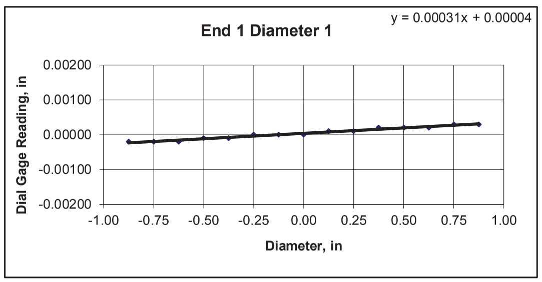
END FLATNESS AND PARALLELISM (Procedure FP1)

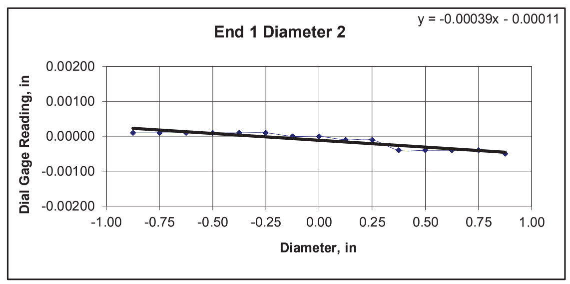
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00020	-0.00020	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00010	0.00010	0.00020	0.00020	0.00020	0.00030	0.00030
Diameter 2, in (rotated 90°)	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000	0.00000	-0.00010	-0.00010	-0.00040	-0.00040	-0.00040	-0.00040	-0.00050

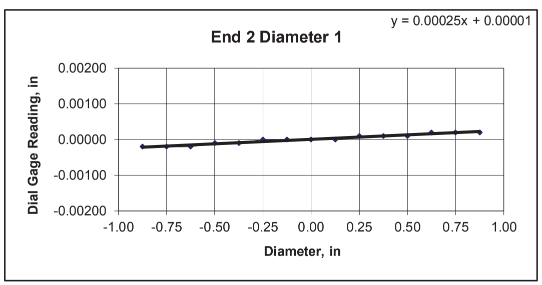
Difference between max and min readings, in:
0° = 0.00050 90° = 0.00060

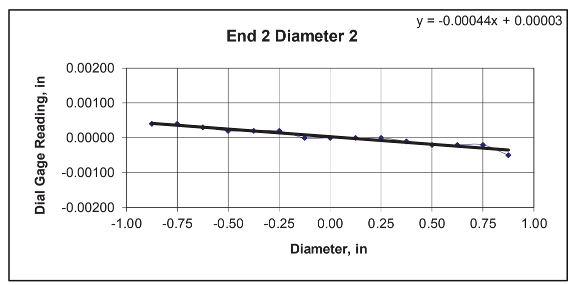
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00020	-0.00020	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00010	0.00020	0.00020	0.00020
Diameter 2, in (rotated 90°)	0.00040	0.00040	0.00030	0.00020	0.00020	0.00020	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00020	-0.00020	-0.00050

Difference between max and min readings, in:
0° = 0.0004 90° = 0.0009
Maximum difference must be < 0.0020 in. Difference = $\pm$ 0.00045
Flatness Tolerance Met? YES









DIAMETER 1

End 1:	Slope of Best Fit Line	0.00031
	Angle of Best Fit Line:	0.01784
End 2:	Slope of Best Fit Line	0.00025
	Angle of Best Fit Line:	0.01441
Maximum Angular Difference:		0.00344

Parallelism Tolerance Met? YES
Spherically Seated

DIAMETER 2

End 1:	Slope of Best Fit Line	0.00039
	Angle of Best Fit Line:	0.02243
End 2:	Slope of Best Fit Line	0.00044
	Angle of Best Fit Line:	0.02505
Maximum Angular Difference:		0.00262

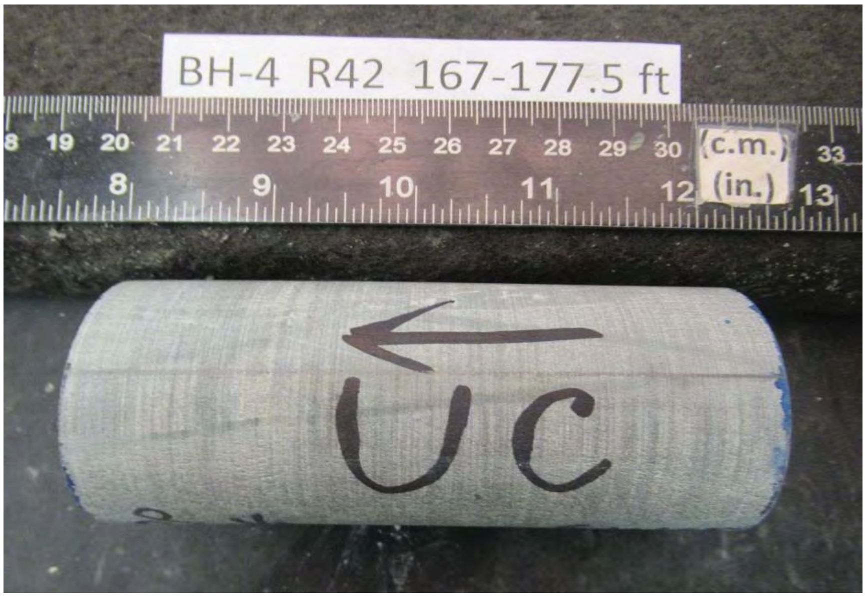
Parallelism Tolerance Met? YES
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00050	1.985	0.00025	0.014	YES
Diameter 2, in (rotated 90°)	0.00060	1.985	0.00030	0.017	YES
END 2					
Diameter 1, in	0.00040	1.985	0.00020	0.012	YES
Diameter 2, in (rotated 90°)	0.00090	1.985	0.00045	0.026	YES

Maximum angle of departure must be $\leq$ 0.25°
Perpendicularity Tolerance Met? YES

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	2/22/2019
Tested By:	cmh
Checked By:	jsc
Boring ID:	BH-4
Sample ID:	R42
Depth, ft:	167-177.5



After cutting and grinding

After break

Client:	S.W. Cole Engineering, Inc.	Test Date:	2/22/2019
Project Name:	NECEC/KRC	Tested By:	cmh
Project Location:	Maine	Checked By:	jsc
GTX #:	309265		
Boring ID:	BH-4		
Sample ID:	R44		
Depth:	176.6-181.6 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	4.49	4.50	4.50
Specimen Diameter, in:	1.99	1.99	1.99
Specimen Mass, g:	615.89		
Bulk Density, lb/ft^3	168	**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	**YES**

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **YES**

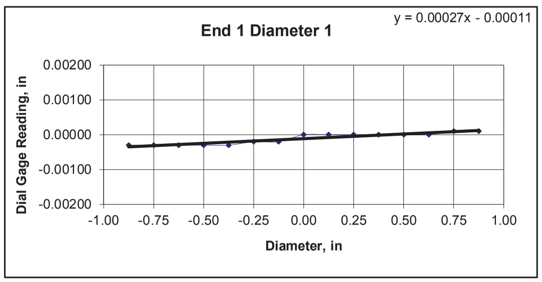
END FLATNESS AND PARALLELISM (Procedure FP1)

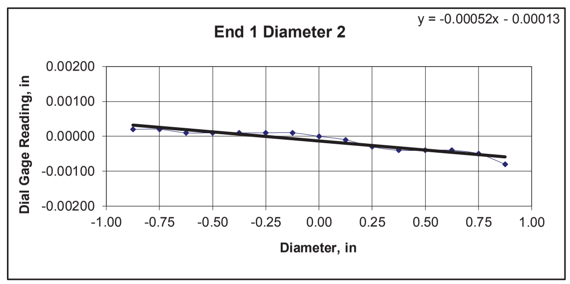
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00030	-0.00030	-0.00030	-0.00030	-0.00030	-0.00020	-0.00020	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010
Diameter 2, in (rotated 90°)	0.00020	0.00020	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000	-0.00010	-0.00030	-0.00040	-0.00040	-0.00040	-0.00050	-0.00080

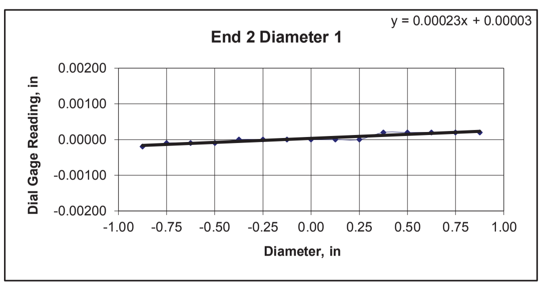
Difference between max and min readings, in:
0° = 0.00040 90° = 0.00100

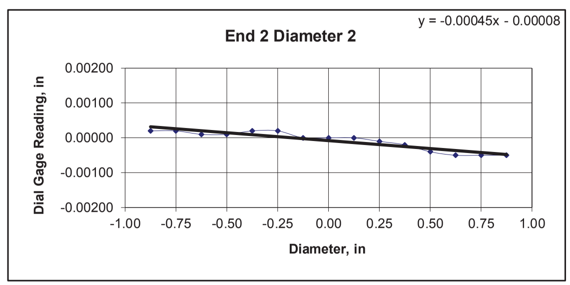
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00020	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00020	0.00020	0.00020	0.00020	0.00020
Diameter 2, in (rotated 90°)	0.00020	0.00020	0.00010	0.00010	0.00020	0.00020	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00040	-0.00050	-0.00050	-0.00050

Difference between max and min readings, in:
0° = 0.0004 90° = 0.0007
Maximum difference must be < 0.0020 in. Difference = ± 0.00050
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00027
Angle of Best Fit Line: 0.01539

End 2:
Slope of Best Fit Line 0.00023
Angle of Best Fit Line: 0.01293

Maximum Angular Difference: 0.00246

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00052
Angle of Best Fit Line: 0.02979

End 2:
Slope of Best Fit Line 0.00045
Angle of Best Fit Line: 0.02603

Maximum Angular Difference: 0.00377

Parallelism Tolerance Met? **YES**
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00040	1.990	0.00020	0.012	YES
Diameter 2, in (rotated 90°)	0.00100	1.990	0.00050	0.029	YES
END 2					
Diameter 1, in	0.00040	1.990	0.00020	0.012	YES
Diameter 2, in (rotated 90°)	0.00070	1.990	0.00035	0.020	YES

Maximum angle of departure must be ≤ 0.25°

Perpendicularity Tolerance Met? **YES**

GeoTesting EXPRESS

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	2/22/2019
Tested By:	cmh
Checked By:	jsc
Boring ID:	BH-4
Sample ID:	R44
Depth, ft:	176.6-181.6

After cutting and grinding

After break

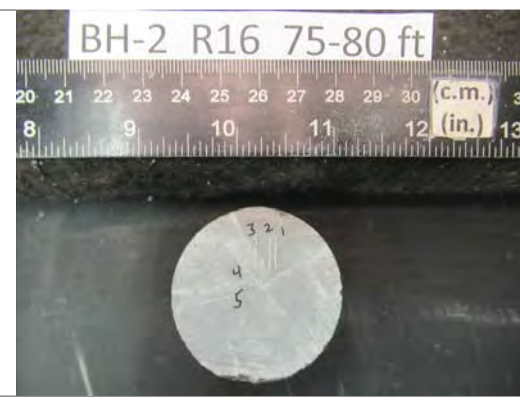
Client:	S.W. Cole Engineering, Inc.				
Project:	NECEC/KRC				
Location:	Maine			Project No:	GTX-309265
Boring ID:	BH-2	Sample Type:	cylinder	Tested By:	smd
Sample ID:	R16	Test Date:	02/25/19	Checked By:	jsc
Depth :	75-80 ft	Test Id:	495043		
Test Comment:	---				
Visual Description:	---				
Sample Comment:	---				

Abrasiveness of Rock Using the Cerchar Method by ASTM D7625

Boring ID	Sample ID	Depth	Stylus No	Reading 1	Reading 2	Average	Comments
BH-2	R16	75-80	1	0.5	0.4	0.45	
			2	1.3	0.5	0.90	
			3	0.4	0.6	0.50	
			4	1.0	0.6	0.80	
			5	0.8	0.7	0.75	
			Average CAIs			0.68	
			Average CAI *			1.15	
			CERCHAR Abrasiveness Index Classification			**Medium abrasiveness**	

Notes

Test Surface: Saw Cut
Moisture Condition: As Received
Apparatus Type: Original CERCHAR
Stylus Hardness: Rockwell Hardess 54/56 HRC
Stylus Displacement Relative to Rock Fabric:
Styli 1-3: Normal; Styli 4-5: Parallel
* CAI = (0.99 * CAIs) + 0.48
CAIs = CERCHAR index for smooth (saw cut) surface
CAI = CERCHAR index for natural surface
Comments:



Client: S.W. Cole Engineering, Inc.			
Project: NECEC/KRC			
Location: Maine		Project No:	GTX-309265
Boring ID: BH-2	Sample Type: cylinder	Tested By:	smd
Sample ID: R18	Test Date: 02/25/19	Checked By:	jsc
Depth : 85-90 ft	Test Id: 495047		
Test Comment: ---			
Visual Description: ---			
Sample Comment: ---			

Abrasiveness of Rock Using the Cerchar Method by ASTM D7625

Boring ID	Sample ID	Depth	Stylus No	Reading 1	Reading 2	Average	Comments
BH-2	R18	85-90	1	1.0	0.6	0.80	
			2	1.0	0.9	0.95	
			3	0.1	0.5	0.30	
			4	0.1	0.4	0.25	
			5	0.6	0.3	0.45	
			Average CAIs			0.55	
			Average CAI *			1.02	
					CERCHAR Abrasiveness Index Classification	Medium abrasiveness	

Notes

Test Surface: Saw Cut
Moisture Condition: As Received
Apparatus Type: Original CERCHAR
Stylus Hardness: Rockwell Hardess 54/56 HRC
Stylus Displacement Relative to Rock Fabric:
Styli 1-3: Normal; Styli 4-5: Parallel
* CAI = (0.99 * CAIs) + 0.48
CAIs = CERCHAR index for smooth (saw cut) surface
CAI = CERCHAR index for natural surface
Comments:

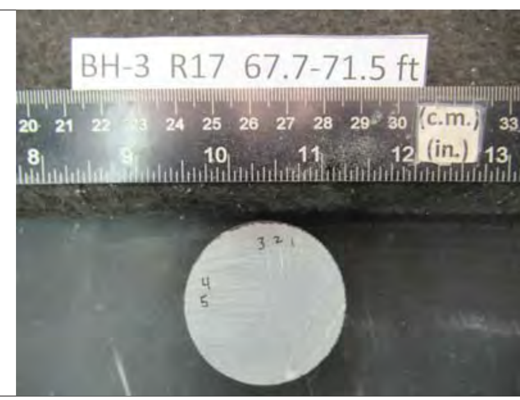
Client: S.W. Cole Engineering, Inc.			
Project: NECEC/KRC			
Location: Maine		Project No:	GTX-309265
Boring ID: BH-3	Sample Type: cylinder	Tested By:	smd
Sample ID: R17	Test Date: 02/25/19	Checked By:	jsc
Depth : 67.7-71.5 ft	Test Id: 495052		
Test Comment: ---			
Visual Description: ---			
Sample Comment: ---			

Abrasiveness of Rock Using the Cerchar Method by ASTM D7625

Boring ID	Sample ID	Depth	Stylus No	Reading 1	Reading 2	Average	Comments
BH-3	R17	67.7-71.5	1	0.5	0.8	0.65	
			2	1.7	1.1	1.40	
			3	0.1	0.3	0.20	
			4	0.4	0.3	0.35	
			5	0.7	0.3	0.50	
			Average CAIs			0.62	
			Average CAI *			1.09	
			CERCHAR Abrasiveness Index Classification			Medium abrasiveness	

Notes

Test Surface: Saw Cut
Moisture Condition: As Received
Apparatus Type: Original CERCHAR
Stylus Hardness: Rockwell Hardess 54/56 HRC
Stylus Displacement Relative to Rock Fabric:
Styli 1-3: Normal; Styli 4-5: Parallel
* CAI = (0.99 * CAIs) + 0.48
CAIs = CERCHAR index for smooth (saw cut) surface
CAI = CERCHAR index for natural surface
Comments:



Client:	S.W. Cole Engineering, Inc.		
Project:	NECEC/KRC		
Location:	Maine	Project No:	GTX-309265
Boring ID: BH-3	Sample Type: cylinder	Tested By:	smd
Sample ID: R25	Test Date: 02/25/19	Checked By:	jsc
Depth : 101.5-106.5 ft	Test Id: 495054		
Test Comment: ---			
Visual Description: ---			
Sample Comment: ---			

Abrasiveness of Rock Using the Cerchar Method by ASTM D7625

Boring ID	Sample ID	Depth	Stylus No	Reading 1	Reading 2	Average	Comments
BH-3	R25	101.5-106.5	1	0.1	0.1	0.10	
			2	0.1	0.1	0.10	
			3	0.1	0.1	0.10	
			4	0.1	0.1	0.10	
			5	0.3	0.1	0.20	
			Average CAIs			0.12	
			Average CAI *			0.60	
			CERCHAR Abrasiveness Index Classification			Low abrasiveness	

Notes

Test Surface: Saw Cut
Moisture Condition: As Received
Apparatus Type: Original CERCHAR
Stylus Hardness: Rockwell Hardess 54/56 HRC
Stylus Displacement Relative to Rock Fabric:
Styli 1-3: Normal; Styli 4-5: Parallel
* CAI = (0.99 * CAIs) + 0.48
CAIs = CERCHAR index for smooth (saw cut) surface
CAI = CERCHAR index for natural surface
Comments:

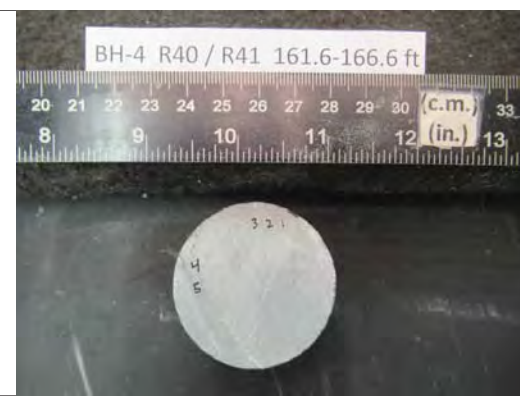
Client:	S.W. Cole Engineering, Inc.		
Project:	NECEC/KRC		
Location:	Maine	Project No:	GTX-309265
Boring ID: BH-4	Sample Type: cylinder	Tested By:	smd
Sample ID: R40 / R41	Test Date: 02/25/19	Checked By:	jsc
Depth : 160-166.6 ft	Test Id: 495062		
Test Comment:	---		
Visual Description:	---		
Sample Comment:	---		

Abrasiveness of Rock Using the Cerchar Method by ASTM D7625

Boring ID	Sample ID	Depth	Stylus No	Reading 1	Reading 2	Average	Comments
BH-4	R40 / R41	161.6-166.6	1	1.2	0.7	0.95	
			2	1.4	1.2	1.30	
			3	0.2	0.1	0.15	
			4	0.4	0.3	0.35	
			5	0.7	0.3	0.50	
			Average CAIs			0.65	
			Average CAI *			1.12	
			CERCHAR Abrasiveness Index Classification			Medium abrasiveness	

Notes

Test Surface: Saw Cut
Moisture Condition: As Received
Apparatus Type: Original CERCHAR
Stylus Hardness: Rockwell Hardess 54/56 HRC
Stylus Displacement Relative to Rock Fabric:
Styli 1-3: Normal; Styli 4-5: Parallel
* CAI = (0.99 * CAIs) + 0.48
CAIs = CERCHAR index for smooth (saw cut) surface
CAI = CERCHAR index for natural surface
Comments:



Client: S.W. Cole Engineering, Inc.
Project: NECEC/KRC
Location: Maine Project No: GTX-309265

Boring ID:	BH-4	Sample Type:	cylinder	Tested By:	smd
Sample ID:	R21	Test Date:	02/25/19	Checked By:	jsc
Depth :	74.6-79.6 ft	Test Id:	495059		

Test Comment: ---
Visual Description: ---
Sample Comment: ---

Abrasiveness of Rock Using the Cerchar Method by ASTM D7625

Boring ID	Sample ID	Depth	Stylus No	Reading 1	Reading 2	Average	Comments
BH-4	R21	74.6-79.6	1	0.2	0.8	0.50	
			2	0.4	0.5	0.45	
			3	1.2	0.9	1.05	
			4	0.3	0.2	0.25	
			5	0.7	0.8	0.75	
			Average CAIs			0.6	
			Average CAI *			1.07	
			CERCHAR Abrasiveness Index Classification			**Medium abrasiveness**	

Notes

Test Surface: Saw Cut
Moisture Condition: As Received
Apparatus Type: Original CERCHAR
Stylus Hardness: Rockwell Hardess 54/56 HRC
Stylus Displacement Relative to Rock Fabric:
Styli 1-3: Normal; Styli 4-5: Parallel
* CAI = (0.99 * CAIs) + 0.48
CAIs = CERCHAR index for smooth (saw cut) surface
CAI = CERCHAR index for natural surface
Comments:

GeoTesting EXPRESS

Client:	S.W. Cole Engineering, Inc.		
Project:	NECEC/KRC		
Location:	Maine	Project No:	GTX-309265
Boring ID: BH-4	Sample Type: cylinder	Tested By:	smd
Sample ID: R44	Test Date: 02/25/19	Checked By:	jsc
Depth : 176.6-181.6 ft	Test Id: 495068		
Test Comment: ---			
Visual Description: ---			
Sample Comment: ---			

Abrasiveness of Rock Using the Cerchar Method by ASTM D7625

Boring ID	Sample ID	Depth	Stylus No	Reading 1	Reading 2	Average	Comments
BH-4	R44	176.6-181.6	1	2.2	2.3	2.25	
			2	2.8	2.5	2.65	
			3	2.7	2.4	2.55	
			4	2.7	3.0	2.85	
			5	2.8	6.0	4.40	
			Average CAIs			2.94	
			Average CAI *			3.39	
CERCHAR Abrasiveness Index Classification						High abrasiveness	

Notes

Test Surface: Saw Cut
Moisture Condition: As Received
Apparatus Type: Original CERCHAR
Stylus Hardness: Rockwell Hardess 54/56 HRC
Stylus Displacement Relative to Rock Fabric:
Styli 1-3: Normal; Styli 4-5: Parallel
* CAI = (0.99 * CAIs) + 0.48
CAIs = CERCHAR index for smooth (saw cut) surface
CAI = CERCHAR index for natural surface
Comments:

Client:	S.W. Cole Engineering, Inc.				
Project:	NECEC/KRC				
Location:	Maine			Project No:	GTX-309265
Boring ID:	BH-2	Sample Type:	cylinder	Tested By:	smd
Sample ID:	R16	Test Date:	03/01/19	Checked By:	jsc
Depth :	75-80 ft	Test Id:	495044		

Test Comment: ---
Visual Description: See photograph(s)
Sample Comment: ---

Slake Durability of Shales and Similar Weak Rocks by ASTM D4644

Boring ID	Sample ID	Depth	Visual Description	Slake Durability Index %	Average water temperature, degrees C	As-Received Water Content %	Description of Fragments
BH-2	R16	75-80	See photograph(s)	99.5	20	0.1	Type I

Comments: Description of the appearance of the fragments retained in the drum:

Type I - Retained pieces remain virtually unchanged

Type II - Retained materials consist of large and small fragments

Type III - Retained material is exclusively small fragments

Before Test:

After Test:

Client: S.W. Cole Engineering, Inc.				
Project: NECEC/KRC				
Location: Maine			Project No:	GTX-309265
Boring ID: BH-3	Sample Type:	cylinder	Tested By:	smd
Sample ID: R25	Test Date:	03/01/19	Checked By:	jsc
Depth : 101.5-106.5 ft	Test Id:	495056		

Test Comment: ---
Visual Description: See photograph(s)
Sample Comment: ---

Slake Durability of Shales and Similar Weak Rocks by ASTM D4644

Boring ID	Sample ID	Depth	Visual Description	Slake Durability Index %	Average water temperature, degrees C	As-Received Water Content %	Description of Fragments
BH-3	R25	101.5-106.5	See photograph(s)	99.4	20	0.1	Type I

Comments: Description of the appearance of the fragments retained in the drum:

Type I - Retained pieces remain virtually unchanged

Type II - Retained materials consist of large and small fragments

Type III - Retained material is exclusively small fragments

Before Test:

After Test:

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Client:	S.W. Cole Engineering, Inc.		
Project:	NECEC/KRC		
Location:	Maine	Project No:	GTX-309265
Boring ID: BH-4	Sample Type: cylinder	Tested By:	smd
Sample ID: R21	Test Date: 03/01/19	Checked By:	jsc
Depth : 74.6-79.6 ft	Test Id: 495060		

Test Comment: ---

Visual Description: See photograph(s)

Sample Comment: ---

Slake Durability of Shales and Similar Weak Rocks by ASTM D4644

Boring ID	Sample ID	Depth	Visual Description	Slake Durability Index %	Average water temperature, degrees C	As-Received Water Content %	Description of Fragments
BH-4	R21	74.6-79.6	See photograph(s)	99.4	20	0.1	Type I

Comments: Description of the appearance of the fragments retained in the drum:

Type I - Retained pieces remain virtually unchanged

Type II - Retained materials consist of large and small fragments

Type III - Retained material is exclusively small fragments

Before Test:

After Test:

Client:	S.W. Cole Engineering, Inc.				
Project:	NECEC/KRC				
Location:	Maine			Project No:	GTX-309265
Boring ID:	BH-4	Sample Type:	cylinder	Tested By:	smd
Sample ID:	R42	Test Date:	03/01/19	Checked By:	jsc
Depth :	167-177.5 ft	Test Id:	495066		
Test Comment:	---				
Visual Description:	See photograph(s)				
Sample Comment:	---				

Slake Durability of Shales and Similar Weak Rocks by ASTM D4644

Boring ID	Sample ID	Depth	Visual Description	Slake Durability Index %	Average water temperature, degrees C	As-Received Water Content %	Description of Fragments
BH-4	R42	167-177.5	See photograph(s)	99.4	20	0.0	Type I

Comments: Description of the appearance of the fragments retained in the drum:

Type I - Retained pieces remain virtually unchanged

Type II - Retained materials consist of large and small fragments

Type III - Retained material is exclusively small fragments

Before Test:

After Test:

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Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	3/12/2019
Tested By:	tlm
Checked By:	jsc
Boring ID:	BH-3
Sample ID:	R23/R24
Depth, ft:	92.1-100.0

Rock Drillability Tests (1) (2)

Test Results:

Brittleness Value S_{20}, (%)	Flakiness, (f)	Compaction Index	Density, (g/cm^3)	Sievers J-Value, (0.1 mm)	Abrasion Value, (mg)	Abrasion Value Steel Cutters, (mg)
46.57	1.49	1	2.74	3.09	1.40	1.75
Medium	---	---	---	**Very High**	**Very Low**	**Very Low**

Calculated Indices:

	Drilling Rate Index	Bit Wear Index	Cutter Life Index
Assessed value	41	24	17.2
Classification Category	**Low**	**Low**	**High**

NTNU/SINTEF Rock Drillability Tests Classifications:

Classification of Indices according to "13A-98 Drillability Test Methods," Dept. of Civil and Transport Engineering, NTNU.

Category	Drilling Rate Index	Bit Wear Index	Cutter Life Index
Extremely Low Very Low	$\leq$ 25 26 - 32	$\leq$ 10 11-20	$\leq$ 5 5.0-5.9
Low	33 - 42	21 - 30	6.0 - 7.9
Medium	43 - 57	31 - 44	8.0 - 14.9
High	58 - 69	45 - 55	15 - 34
Very High Extremely High	70 - 82 $\geq$ 83	56 - 69 $\geq$ 70	35 - 74 $\geq$ 75

Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
2. The trademarked acronyms and terms DRI™, BWI™, CLI™ BWI™, SAT™, Bit Wear Index™, Cutter Life Index™ and Soil Abrasion Test™ are unique for test results and calculated indices originating from NTNU/SINTEF and can only be obtained by testing samples at their reference laboratory in Trondheim, Norway.
3. Samples were delivered to GTX by client.
4. Testing was done on best representative rock specimens from samples provided.
5. Samples were stored at 20° $\pm$ 5° C for a minimum of 48 hrs before testing.
6. Assessed values were measured by NTNU/SINTEF's Hard Rock Tunnel Boring Drillability Test Methods figures.

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	43536
Tested By:	tlm
Checked By:	jsc
Boring ID:	BH-3
Sample ID:	R23/R24
Depth, ft:	92.1-100.0

Rock Drillability Tests

Notes:
1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
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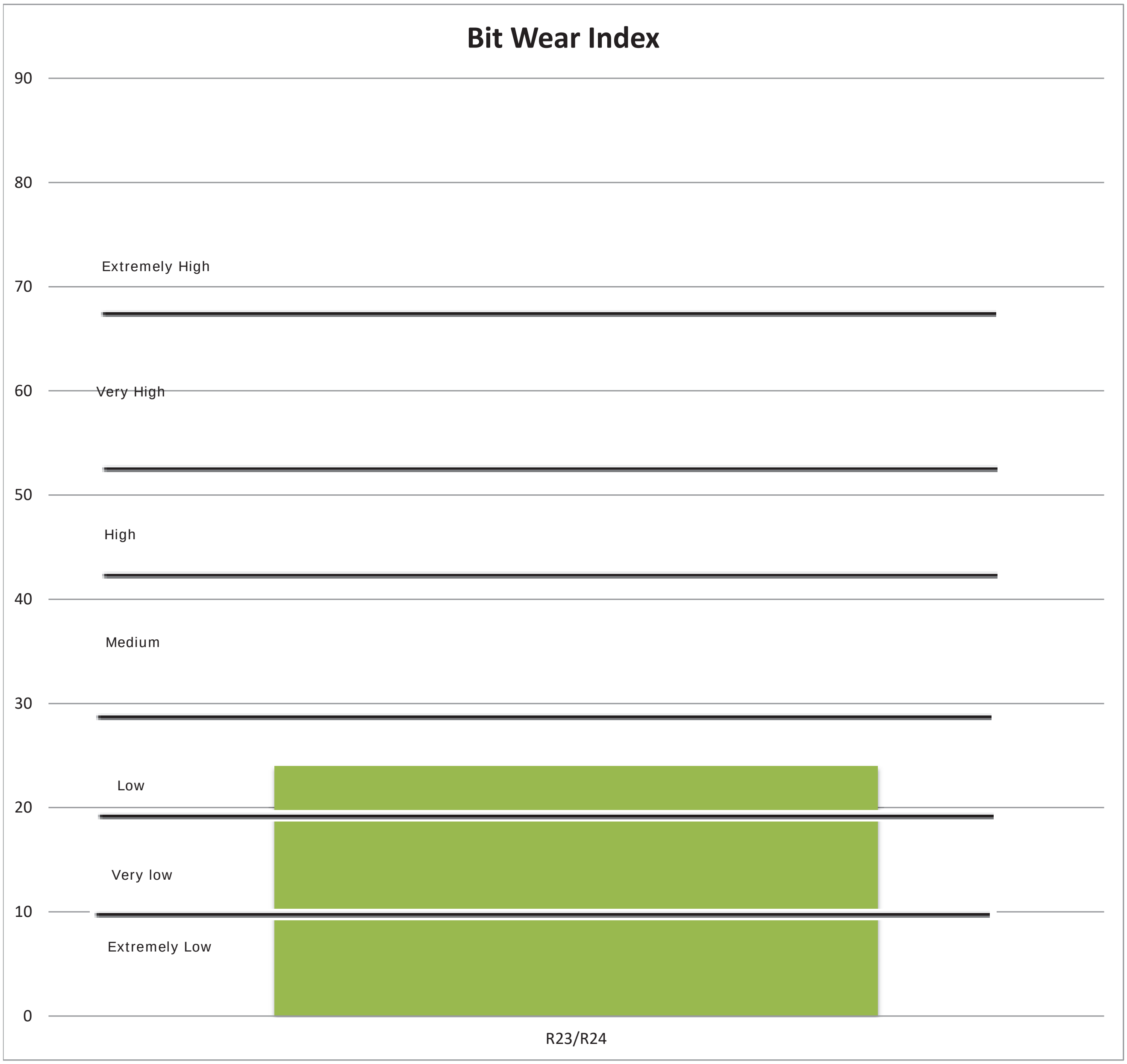
Rock Drillability Tests



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Rock Drillability Tests

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GTX #:	309265
Boring ID:	BH-3
Sample ID:	R23/R24
Depth, ft:	92.1-100.0

Rock Drillability - Sample As-Received

(* indicates location of Sievers' J-Value sampling)

Notes:

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Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	3/12/2019
Tested By:	tlm
Checked By:	jsc
Boring ID:	BH-3
Sample ID:	R23/R24
Depth, ft:	92.1-100.0

Rock Drillability - Brittleness Value

Individual Test Results

Test Number	Brittleness Value, S_{20} (%)
1	27.4
2	51.0
3	61.3
Average	46.6

Sample classification: Medium

Brittleness Value Reference Classification Chart

Category	Brittleness Value, S_{20} (%)
Extremely Low	$\leq$ 29.0
Very Low	29.1 - 34.9
Low	35.0 - 40.9
Medium	41.0 - 50.9
High	51.0 - 59.9
Very High	60.0 - 65.9
Extremely High	$\geq$ 66.0

Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
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3. The Brittleness Value test is performed on three extractions from one representative and homogenized sample of crushed and sieved rock material. When there is not enough material provided to perform the three tests, one or two tests may be performed.

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	3/5/2019
Tested By:	tlm
Checked By:	jsc
Boring ID:	BH-3
Sample ID:	R23/R24
Depth, ft:	92.1-100.0

Rock Drillability - Sievers' J-Value

Individual Test Results

Test Number	Sievers' J-Value SJ (1/10 mm)
1	2.15
2	5.25
3	1.33
4	4.00
5	2.70
Average	3.09

Sample Classification: Very High

Sievers' J-Value Reference Classification Chart

Category	SJ-Value (1/10 mm)
Extremely High	$\leq$ 2.0
Very High	2.1 - 3.9
High	4.0 - 6.9
Medium	7.0 - 18.9
Low	19.0 - 55.9
Very Low	56.0 - 85.9
Extremely Low	$\geq$ 86.0

Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003. The Suggested DRI, BWI, CLI Standard.
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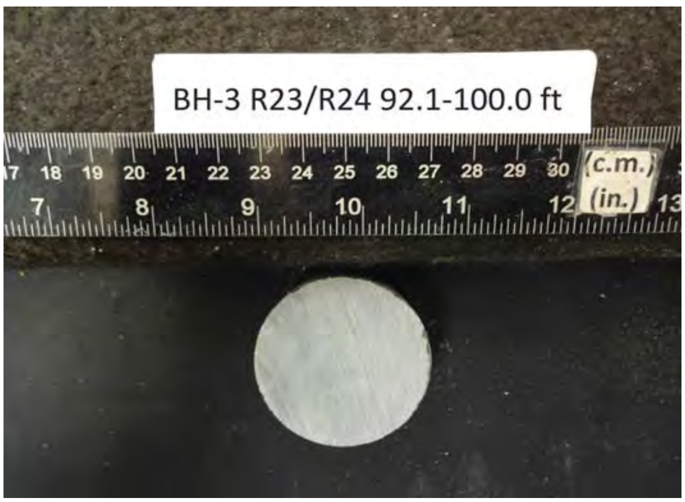
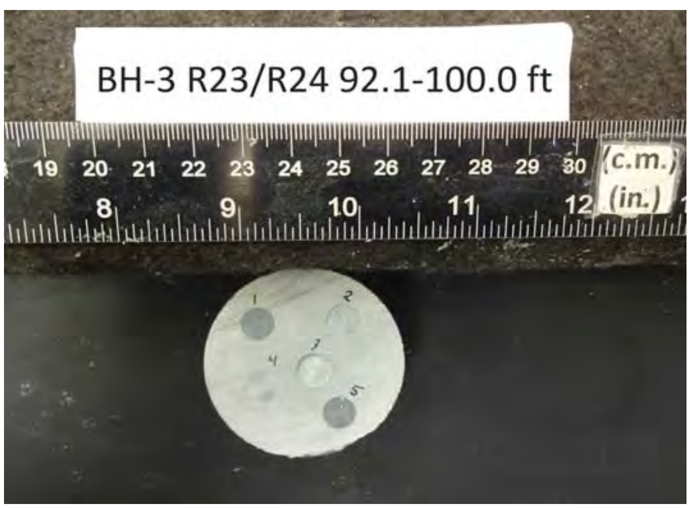
3. The standard number of Sievers' J drillings performed on each sample is 4 to 8, depending on the variation in the texture of the sample. Drilling locations were selected to be tested on 60% hard and 40% softer layers found in the sample. Soft/hard combinations at drill locations are avoided as best as possible to try to give a more accurate representation of the rock. This is however impossible in samples which have alternating soft and hard layered mineral composition. The average Sievers' J value is regarded as representative for the tested rock.
4. Test was performed at 197 RPM.

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	3/5/2019
Tested By:	tlm
Checked By:	jsc
Boring ID:	BH-3
Sample ID:	R23/R24
Depth, ft:	92.1-100.0

Rock Drillability - Sievers' J-Value Sample



Sample before testing



After testing showing drill locations

Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
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GeoTesting EXPRESS

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Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	3/12/2019
Tested By:	tlm
Checked By:	jsc
Boring ID:	BH-3
Sample ID:	R23/R24
Depth, ft:	92.1-100.0

Rock Drillability - Abrasion Value (AV)

Individual Test Results

Test Number	Abrasion Value AV (mg)
1	1.70
2	1.10
Average	1.40

Sample Classification: Very Low

Abrasion Value Reference Classification Chart

Category	AV (mg)
Extremely Low	$\leq$ 1.0
Very Low	1.1 - 3.9
Low	4.0 - 10.9
Medium	11.0 - 27.9
High	28.0 - 41.9
Very High	42.0 - 57.9
Extremely High	$\geq$ 58.0

Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
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3. Abrasion test material was taken from the extractions used for the Brittleness Value test. The AV test pieces are comprised of tungsten carbide. Grain size, shape and binding are some factors that are believed to have substantial influence on the abrasiveness of the rock.
4. Test was performed at 20 RPM for 5 mins for a total of 100 revolutions

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	3/12/2019
Tested By:	tlm
Checked By:	jsc
Boring ID:	BH-3
Sample ID:	R23/R24
Depth, ft:	92.1-100.0

Rock Drillability - Abrasion Value Cutter Steel (AVS)

Individual Test Results

Test Number	Abrasion Value Cutter Steel AVS (mg)
1	1.60
2	1.90
Average	1.75

Sample Classification: Very Low

Abrasion Value Cutter Steel Reference Classification Chart

Category	AVS (mg)
Extremely Low	$\leq$ 1.0
Very Low	1.1 - 3.9
Low	4.0 - 12.9
Medium	13.0 - 25.9
High	26.0 - 35.9
Very High	36.0 - 43.9
Extremely High	$\geq$ 44.0

Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
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3. Abrasion test material was taken from the extractions used for the Brittleness Value test. The AVS test pieces are comprised of cutter ring steel. Grain size, shape and binding are some factors that are believed to have substantial influence on the abrasiveness of the rock.
4. Test was performed at 20 RPM for 1 minute for a total of 20 revolutions.

Rock Drillability Test Equipment

Brittleness test equipment

An example sample prior to impacts

An example sample after 20 impacts

Notes:

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Rock Drillability Test Equipment


Sievers' J-Value Apparatus


Closeup of Sievers J-Value Apparatus with sample

Sievers' J-Value untested drillbits

Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
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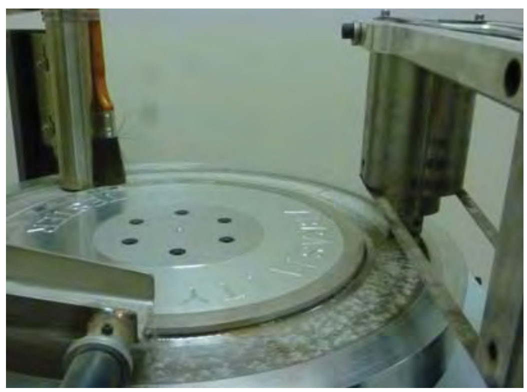
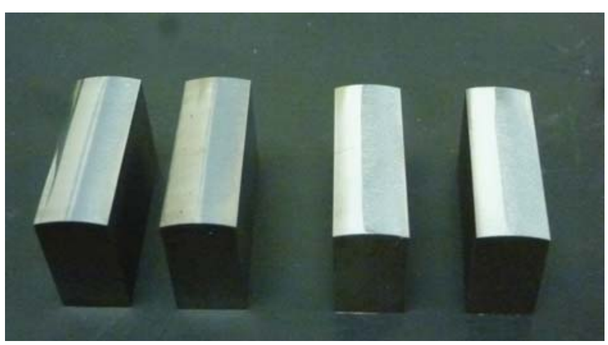
GeoTesting EXPRESS

Rock Drillability Test Equipment

Abrasivity machine



Closeup of Abrasivity machine with sample



AV (left) & AVS (right) bits showing wear from testing

Notes:

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Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	3/12/2019
Tested By:	tlm
Checked By:	jsc
Boring ID:	BH-4
Sample ID:	R40/R41
Depth, ft:	160-166.6

Rock Drillability Tests (1) (2)

Test Results:

Brittleness Value S_{20}, (%)	Flakiness, (f)	Compaction Index	Density, (g/cm^3)	Sievers J-Value, (0.1 mm)	Abrasion Value, (mg)	Abrasion Value Steel Cutters, (mg)
45.75	1.4	1	2.73	5.64	1.85	2.75
Medium	---	---	---	**High**	**Very Low**	**Very Low**

Calculated Indices:

	Drilling Rate Index	Bit Wear Index	Cutter Life Index
Assessed value	44	23	18.2
Classification Category	**Medium**	**Low**	**High**

NTNU/SINTEF Rock Drillability Tests Classifications:

Classification of Indices according to "13A-98 Drillability Test Methods," Dept. of Civil and Transport Engineering, NTNU.

Category	Drilling Rate Index	Bit Wear Index	Cutter Life Index
Extremely Low Very Low	$\leq$ 25 26 - 32	$\leq$ 10 11-20	$\leq$ 5 5.0-5.9
Low	33 - 42	21 - 30	6.0 - 7.9
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Notes:

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Rock Drillability Tests

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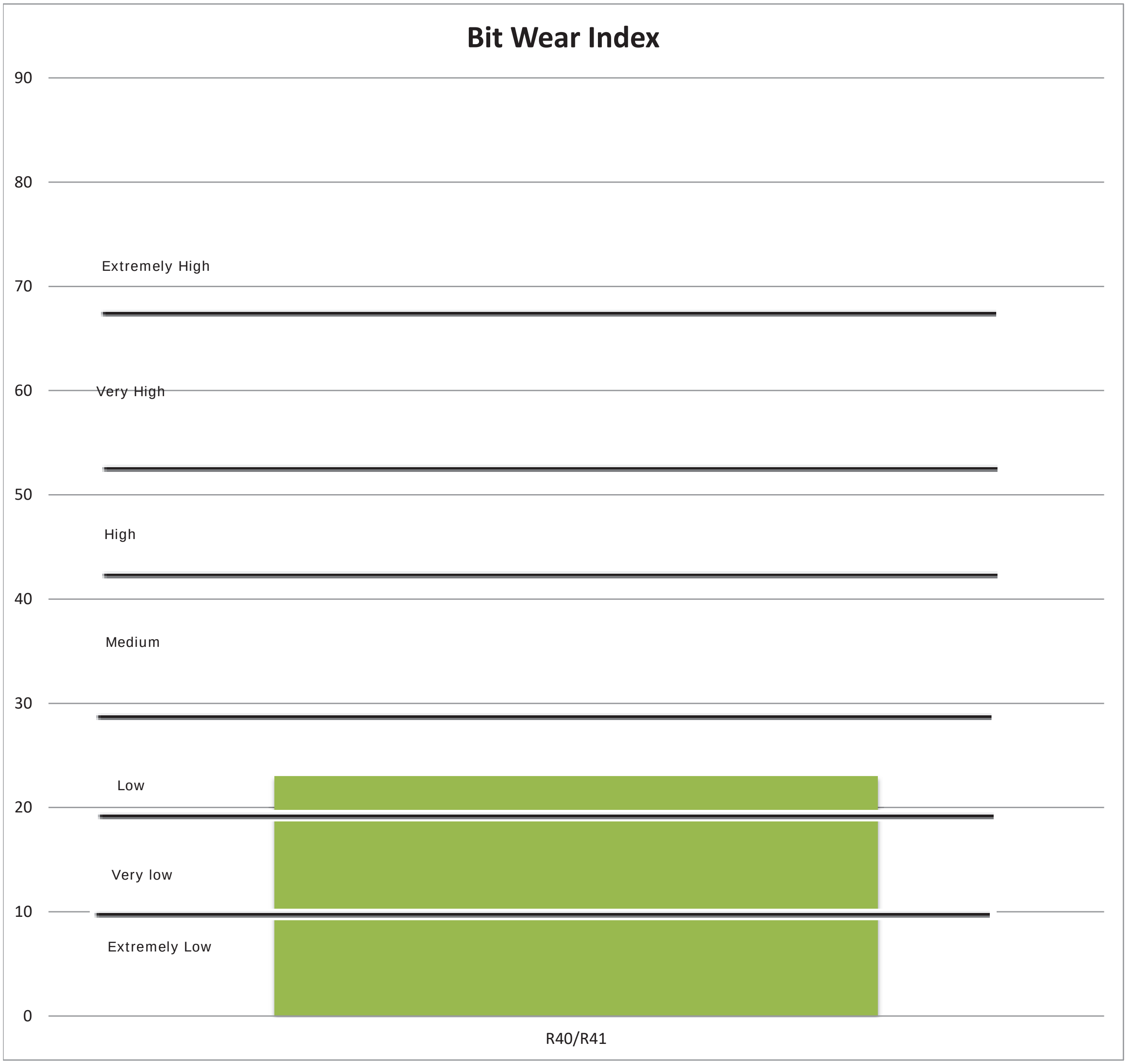
Rock Drillability Tests



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Rock Drillability Tests

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Depth, ft:	160-166.6

Rock Drillability - Sample As-Received

(* indicates location of Sievers' J-Value sampling)

Notes:

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Tested By:	tlm
Checked By:	jsc
Boring ID:	BH-4
Sample ID:	R40/R41
Depth, ft:	160-166.6

Rock Drillability - Brittleness Value

Individual Test Results

Test Number	Brittleness Value, S_{20} (%)
1	28.95
2	49.48
3	58.83
Average	45.75

Sample classification: Medium

Brittleness Value Reference Classification Chart

Category	Brittleness Value, S_{20} (%)
Extremely Low	$\leq$ 29.0
Very Low	29.1 - 34.9
Low	35.0 - 40.9
Medium	41.0 - 50.9
High	51.0 - 59.9
Very High	60.0 - 65.9
Extremely High	$\geq$ 66.0

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GTX #:	309265
Test Date:	3/5/2019
Tested By:	tlm
Checked By:	jsc
Boring ID:	BH-4
Sample ID:	R40/R41
Depth, ft:	160.50-160.40

Rock Drillability - Sievers' J-Value

Individual Test Results

Test Number	Sievers' J-Value SJ (1/10 mm)
1	1.60
2	1.60
3	0.75
4	22.00
5	2.25
Average	5.64

Sample Classification: High

Sievers' J-Value Reference Classification Chart

Category	SJ-Value (1/10 mm)
Extremely High	$\leq$ 2.0
Very High	2.1 - 3.9
High	4.0 - 6.9
Medium	7.0 - 18.9
Low	19.0 - 55.9
Very Low	56.0 - 85.9
Extremely Low	$\geq$ 86.0

Notes:

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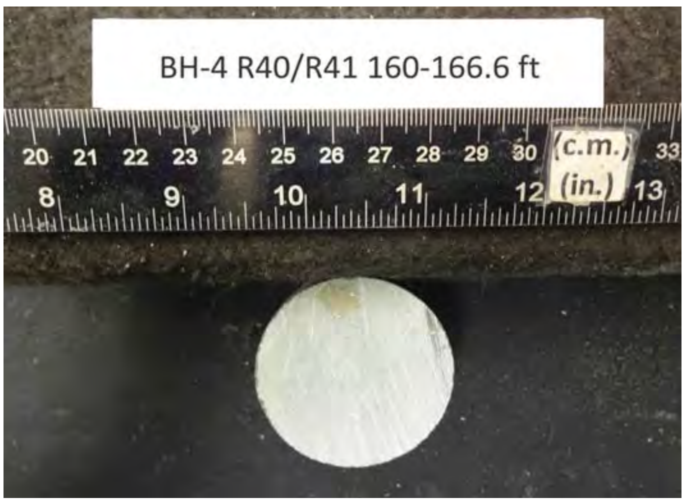
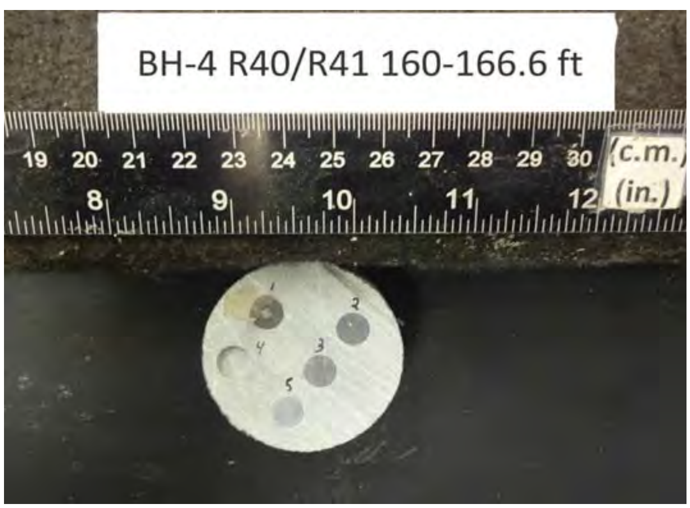
4. Test was performed at 197 RPM.

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	3/5/2019
Tested By:	jsc
Checked By:	mpd
Boring ID:	BH-4
Sample ID:	R40/R41
Depth, in:	160.50-160.40

Rock Drillability - Sievers' J-Value Sample



Sample before testing



After testing showing drill locations

Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
2. The trademarked acronyms and terms DRI™, BWI™, CLI™ BWI™, SAT™, Bit Wear Index™, Cutter Life Index™ and Soil Abrasion Test™ are unique for test results and calculated indices originating from NTNU/SINTEF and can only be obtained by testing samples at their reference laboratory in Trondheim, Norway.

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	3/12/2019
Tested By:	tlm
Checked By:	jsc
Boring ID:	BH-4
Sample ID:	R40/R41
Depth, ft:	160-166.6

Rock Drillability - Abrasion Value (AV)

Individual Test Results

Test Number	Abrasion Value AV (mg)
1	2.20
2	1.50
Average	1.85

Sample Classification: Very Low

Abrasion Value Reference Classification Chart

Category	AV (mg)
Extremely Low	≤ 1.0
Very Low	1.1 - 3.9
Low	4.0 - 10.9
Medium	11.0 - 27.9
High	28.0 - 41.9
Very High	42.0 - 57.9
Extremely High	≥ 58.0

Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
2. The trademarked acronyms and terms DRI™, BWI™, CLI™ BWI™, SAT™, Bit Wear Index™, Cutter Life Index™ and Soil Abrasion Test™ are unique for test results and calculated indices originating from NTNU/SINTEF and can only be obtained by testing samples at their reference laboratory in Trondheim, Norway.
3. Abrasion test material was taken from the extractions used for the Brittleness Value test. The AV test pieces are comprised of tungsten carbide. Grain size, shape and binding are some factors that are believed to have substantial influence on the abrasiveness of the rock.
4. Test was performed at 20 RPM for 5 mins for a total of 100 revolutions

Client:	S.W. Cole Engineering, Inc.
Project Name:	NECEC/KRC
Project Location:	Maine
GTX #:	309265
Test Date:	3/12/2019
Tested By:	tlm
Checked By:	jsc
Boring ID:	BH-4
Sample ID:	R40/R41
Depth, ft:	160-166.6

Rock Drillability - Abrasion Value Cutter Steel (AVS)

Individual Test Results

Test Number	Abrasion Value Cutter Steel AVS (mg)
1	2.90
2	2.60
Average	2.75

Sample Classification: Very Low

Abrasion Value Cutter Steel Reference Classification Chart

Category	AVS (mg)
Extremely Low	≤ 1.0
Very Low	1.1 - 3.9
Low	4.0 - 12.9
Medium	13.0 - 25.9
High	26.0 - 35.9
Very High	36.0 - 43.9
Extremely High	≥ 44.0

Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
2. The trademarked acronyms and terms DRI™, BWI™, CLI™ BWI™, SAT™, Bit Wear Index™, Cutter Life Index™ and Soil Abrasion Test™ are unique for test results and calculated indices originating from NTNU/SINTEF and can only be obtained by testing samples at their reference laboratory in Trondheim, Norway.
3. Abrasion test material was taken from the extractions used for the Brittleness Value test. The AVS test pieces are comprised of cutter ring steel. Grain size, shape and binding are some factors that are believed to have substantial influence on the abrasiveness of the rock.
4. Test was performed at 20 RPM for 1 minute for a total of 20 revolutions.

Rock Drillability Test Equipment

Brittleness test equipment

An example sample prior to impacts

An example sample after 20 impacts

Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
2. The trademarked acronyms and terms DRI™, BWI™, CLI™ BWI™, SAT™, Bit Wear Index™, Cutter Life Index™ and Soil Abrasion Test™ are unique for test results and calculated indices originating from NTNU/SINTEF and can only be obtained by testing samples at their reference laboratory in Trondheim, Norway.

Rock Drillability Test Equipment

Sievers' J-Value Apparatus

Closeup of Sievers J-Value Apparatus with sample

Sievers' J-Value untested drillbits

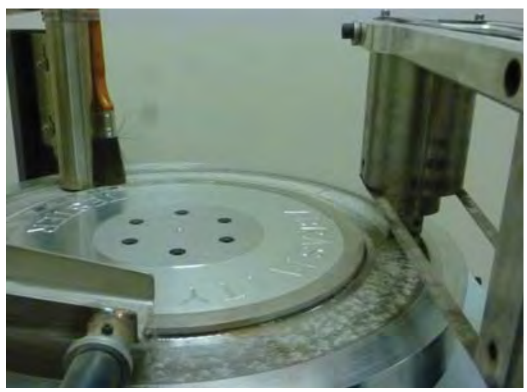
Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
2. The trademarked acronyms and terms DRI™, BWI™, CLI™ BWI™, SAT™, Bit Wear Index™, Cutter Life Index™ and Soil Abrasion Test™ are unique for test results and calculated indices originating from NTNU/SINTEF and can only be obtained by testing samples at their reference laboratory in Trondheim, Norway.

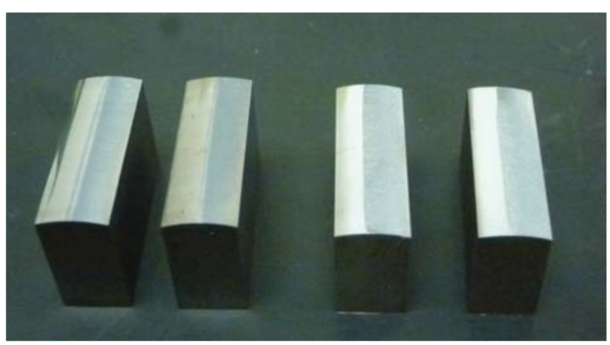
GeoTesting EXPRESS

Rock Drillability Test Equipment

Abrasivity machine



Closeup of Abrasivity machine with sample



AV (left) & AVS (right) bits showing wear from testing

Notes:

1. GeoTesting Express's Rock Drillability testing suite is based on NTNU/SINTEF's 13A-98 Drillability Test Methods, Dept. of Civil and Transportation Engineering and performed in accordance with Dahl, Filip, 2003, The Suggested DRI, BWI, CLI Standard.
2. The trademarked acronyms and terms DRI™, BWI™, CLI™ BWI™, SAT™, Bit Wear Index™, Cutter Life Index™ and Soil Abrasion Test™ are unique for test results and calculated indices originating from NTNU/SINTEF and can only be obtained by testing samples at their reference laboratory in Trondheim, Norway.

2/12/19

BLACK & VEATCH

LABORATORY TEST ASSIGNMENTS

Client	Central Maine Power		Prepared By	T. Bonnie
Plant	NECEC - Keneebec River HDD		Revision	0
Project No.	400319		Date Requested	February 7, 2019
Lab Contractor	SW Cole		Completion Due Date	
Lab Supervisor				

Boring No.	Sample No.	Depth	Sample Type	Logged Soil Type	% or Length Recovery	Moisture Content	Density	Liquid Limit	Plastic Limit	Percent < #200	Sieve Analysis	Hydrometer Analysis	Unconfined Compression	Triaxial UU	Confining Pressures (ksf)	CERCHAR Abrasivity Index	Slake	petrographic	Drill-ability	Comments
BH-2	R16	75 -80	RC	Siltstone	100%								X			x	X	X		
BH-2	R18	85-90	RC	Siltstone	100%								x			x				
BH-3	Composite of R23 (92.1 to 96.5 ft) + R24 (96.5 to 100.0 ft)	See depths under Sample No.	RC	Slate	100%								X Run UCS test on R24 somewhere between 96.5 and 98.5 ft prior to running Drillability testing. After UCS test, combine failed UCS specimen with R23/24 composite sample and run Drillability testing.					X (see Comment)	X	Obtain petrographic sample somewhere between 96.5 to 98.5 ft.
BH-3	R24	100-101.5	RC	Slate	100%											X	X			
BH-3	R17	67.7-71.5	RC	Phyllite	100%								x			x		X		
BH-3	R25	101.5-106.5	RC	Slate	100%											x	X	X		
BH-4	R21	74.6 - 79.6	RC	slate	100%								x			x	X	X		
BH-4	Composite of R40 (160 to 161.6 ft) + R41 (161.6 to 166.6 ft)	See depths under Sample No.	RC	Siltstone	100%											X		X	X	
BH-4	R42	167-177.5	RC	Siltstone	100%								X				X			
BH-4	R44	176.6-181.6	RC	Phyllite	100%								x			x		X		

NOTE - Sample No. based on elevation of HDD vertical alignment shown on Plan & Profile Dwg. Rev B by TRC dated 10/17/18 and corresponding elevation on test boring logs in Geotechnical Data report by S.W. Cole dated December 20, 2018. Depth noted is from S.W. Cole report.

GEOTESTING EXPRESS
ATTN: JOHN CAMBELL
125 NAGOG PARK
ACTON, MA 01720

JOHN - THIS IS THE SPREAD SHEET PROVIDED TO SW COLE BY BLACK & VEATCH. THE ROCK CORE IS ALL LABELED. SOME MAY SAY BH-(19)-4 BUT THIS IS THE SAME AS BH-4 ON THIS SHEET. PLEASE REPORT USING BH-2, BH-3 and BH-4 NOTATION. REPORTS AND INVOICE SHOULD GO TO S.W. COLE ENG, INC. ATTN: PAUL KOHLER
pkohler@swcole.com
SWCE PROJECT NO: 18-0345
FOR: CMP/KRC

THANKS
PAUL
207-517-4867 (DESK)
207-615-2760 (CELL)

WARRANTY and LIABILITY

GeoTesting Express (GTX) warrants that all tests it performs are run in general accordance with the specified test procedures and accepted industry practice. GTX will correct or repeat any test that does not comply with this warranty. GTX has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

GTX may report engineering parameters that require us to interpret the test data. Such parameters are determined using accepted engineering procedures. However, GTX does not warrant that these parameters accurately reflect the true engineering properties of the *in situ* material. Responsibility for interpretation and use of the test data and these parameters for engineering and/or construction purposes rests solely with the user and not with GTX or any of its employees.

GTX's liability will be limited to correcting or repeating a test which fails our warranty. GTX's liability for damages to the Purchaser of testing services for any cause whatsoever shall be limited to the amount GTX received for the testing services. GTX will not be liable for any damages, or for any lost benefits or other consequential damages resulting from the use of these test results, even if GTX has been advised of the possibility of such damages. GTX will not be responsible for any liability of the Purchaser to any third party.

Commonly Used Symbols

A	pore pressure parameter for $\Delta\sigma_1 - \Delta\sigma_3$
B	pore pressure parameter for $\Delta\sigma_3$
CAI	CERCHAR Abrasiveness Index
CIU	isotropically consolidated undrained triaxial shear test
CR	compression ratio for one dimensional consolidation
CSR	cyclic stress ratio
C_c	coefficient of curvature, $(D_{30})^2 / (D_{10} \text{ x } D_{60})$
C_u	coefficient of uniformity, D_{60}/D_{10}
C_c	compression index for one dimensional consolidation
C_α	coefficient of secondary compression
c_v	coefficient of consolidation
c	cohesion intercept for total stresses
c'	cohesion intercept for effective stresses
D	diameter of specimen
D	damping ratio
D_{10}	diameter at which 10% of soil is finer
D_{15}	diameter at which 15% of soil is finer
D_{30}	diameter at which 30% of soil is finer
D_{50}	diameter at which 50% of soil is finer
D_{60}	diameter at which 60% of soil is finer
D_{85}	diameter at which 85% of soil is finer
d_{50}	displacement for 50% consolidation
d_{90}	displacement for 90% consolidation
d_{100}	displacement for 100% consolidation
E	Young's modulus
e	void ratio
e_c	void ratio after consolidation
e_o	initial void ratio
G	shear modulus
G_s	specific gravity of soil particles
H	height of specimen
H_R	Rebound Hardness number
i	gradient
I_S	Uncorrected point load strength
$I_{S(50)}$	Size corrected point load strength index
H_A	Modified Taber Abrasion
H_T	Total hardness
K_o	lateral stress ratio for one dimensional strain
k	permeability
LI	Liquidity Index
m_v	coefficient of volume change
n	porosity
PI	plasticity index
P_c	preconsolidation pressure
p	$(\sigma_1 + \sigma_3) / 2$, $(\sigma_v + \sigma_h) / 2$
p'	$(\sigma'_1 + \sigma'_3) / 2$, $(\sigma'_v + \sigma'_h) / 2$
p'_c	p' at consolidation
Q	quantity of flow
q	$(\sigma_1 - \sigma_3) / 2$
q_f	q at failure
q_o, q_i	initial q
q_c	q at consolidation
S_r	Post cyclic undrained shear strength
T	temperature
t	time
U, UC	unconfined compression test
UU, Q	unconsolidated undrained triaxial test
u_a	pore gas pressure
u_e	excess pore water pressure
u, u_w	pore water pressure
V	total volume
V_g	volume of gas
V_s	volume of solids
V_s	shear wave velocity
V_v	volume of voids
V_w	volume of water
V_o	initial volume
v	velocity
W	total weight
W_s	weight of solids
W_w	weight of water
w	water content
w_c	water content at consolidation
w_f	final water content
w_l	liquid limit
w_n	natural water content
w_p	plastic limit
w_s	shrinkage limit
w_o, w_i	initial water content
α	slope of q_f versus p_f
α'	slope of q_f versus p_f'
γ_t	total unit weight
γ_d	dry unit weight
γ_s	unit weight of solids
γ_w	unit weight of water
ε	strain
ε_{vol}	volume strain
ε_h, ε_v	horizontal strain, vertical strain
μ	Poisson's ratio, also viscosity
σ	normal stress
σ'	effective normal stress
σ_c, σ'_c	consolidation stress in isotropic stress system
σ_h, σ'_h	horizontal normal stress
σ_v, σ'_v	vertical normal stress
σ'_{vc}	Effective vertical consolidation stress
σ_1	major principal stress
σ_2	intermediate principal stress
σ_3	minor principal stress
τ	shear stress
φ	friction angle based on total stresses
φ'	friction angle based on effective stresses
φ'_r	residual friction angle
φ_{ult}	φ for ultimate strength

ANALYTICAL REPORT

Lab Number:	L1845199
Client:	S. W. Cole Engineering, Inc. 37 Liberty Drive Bangor, ME 04401-5784
ATTN:	Nate Strout
Phone:	(207) 657-2866
Project Name:	NECEC, KRC
Project Number:	18-0345
Report Date:	11/14/18

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0574), IL (200077), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #P330-17-00196).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: NECEC, KRC
Project Number: 18-0345

Lab Number: L1845199
Report Date: 11/14/18

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1845199-01	BH-1, 2D, 2-4'	SOIL	WEST FORKS PLANTATION, ME	10/30/18 10:00	11/05/18
L1845199-02	BH-2, 1D, 0.4-2'	SOIL	WEST FORKS PLANTATION, ME	10/30/18 14:45	11/05/18
L1845199-03	BH-5, 3D, 5-7'	SOIL	WEST FORKS PLANTATION, ME	11/02/18 15:15	11/05/18

Project Name: NECEC, KRC
Project Number: 18-0345

Lab Number: L1845199
Report Date: 11/14/18

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. All specific QC information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY
For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Kelly Stenstrom

Title: Technical Director/Representative

Date: 11/14/18

INORGANICS
&
MISCELLANEOUS

Project Name: NECEC, KRC
Project Number: 18-0345

Lab Number: L1845199
Report Date: 11/14/18

SAMPLE RESULTS

Lab ID: L1845199-01
Client ID: BH-1, 2D, 2-4'
Sample Location: WEST FORKS PLANTATION, ME

Date Collected: 10/30/18 10:00
Date Received: 11/05/18
Field Prep: Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	92.2		%	0.100	NA	1	-	11/06/18 10:03	121,2540G	RI
Chloride	ND		mg/kg	11	--	1	-	11/12/18 20:12	1,9251	ML
pH (H)	6.0		SU	-	NA	1	-	11/06/18 15:00	1,9045D	LH
Sulfate	ND		mg/kg	110	--	1	-	11/07/18 13:02	1,9038	BR
Moisture	7.80		%	0.100	NA	1	-	11/06/18 10:03	121,2540G	RI

Project Name:	NECEC, KRC	**Lab Number:**	L1845199
Project Number:	18-0345	**Report Date:**	11/14/18

SAMPLE RESULTS

Lab ID:	L1845199-02	Date Collected:	10/30/18 14:45
Client ID:	BH-2, 1D, 0.4-2'	Date Received:	11/05/18
Sample Location:	WEST FORKS PLANTATION, ME	Field Prep:	Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	84.6		%	0.100	NA	1	-	11/06/18 10:03	121,2540G	RI
Chloride	ND		mg/kg	11	--	1	-	11/12/18 20:14	1,9251	ML
pH (H)	7.5		SU	-	NA	1	-	11/06/18 15:00	1,9045D	LH
Sulfate	ND		mg/kg	120	--	1	-	11/07/18 13:02	1,9038	BR
Moisture	15.4		%	0.100	NA	1	-	11/06/18 10:03	121,2540G	RI

Project Name: NECEC, KRC
Project Number: 18-0345
Lab Number: L1845199
Report Date: 11/14/18

SAMPLE RESULTS

Lab ID: L1845199-03
Client ID: BH-5, 3D, 5-7'
Sample Location: WEST FORKS PLANTATION, ME
Date Collected: 11/02/18 15:15
Date Received: 11/05/18
Field Prep: Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	89.1		%	0.100	NA	1	-	11/06/18 10:03	121,2540G	RI
Chloride	ND		mg/kg	9.5	--	1	-	11/12/18 20:15	1,9251	ML
pH (H)	6.4		SU	-	NA	1	-	11/06/18 15:00	1,9045D	LH
Sulfate	ND		mg/kg	110	--	1	-	11/07/18 13:02	1,9038	BR
Moisture	10.9		%	0.100	NA	1	-	11/06/18 10:03	121,2540G	RI

Project Name: NECEC, KRC **Lab Number:** L1845199
Project Number: 18-0345 **Report Date:** 11/14/18

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01-03 Batch: WG1176859-1										
Sulfate	ND		mg/kg	100	--	1	-	11/07/18 13:02	1,9038	BR
General Chemistry - Westborough Lab for sample(s): 01-03 Batch: WG1178627-1										
Chloride	ND		mg/kg	10	--	1	-	11/12/18 19:47	1,9251	ML

Lab Control Sample Analysis
Batch Quality Control

Project Name: NECEC, KRC
Project Number: 18-0345

Lab Number: L1845199
Report Date: 11/14/18

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-03 Batch: WG1176501-1								
pH	100		-		99-101	-		
General Chemistry - Westborough Lab Associated sample(s): 01-03 Batch: WG1176859-2								
Sulfate	105		-		80-121	-		12
General Chemistry - Westborough Lab Associated sample(s): 01-03 Batch: WG1178627-2								
Chloride	105		-		89-109	-		35

Matrix Spike Analysis
Batch Quality Control

Project Name: NECEC, KRC
Project Number: 18-0345

Lab Number: L1845199
Report Date: 11/14/18

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-03 QC Batch ID: WG1176859-4 QC Sample: L1845199-01 Client ID: BH-1, 2D, 2-4'												
Sulfate	ND	216	230	110		-	-		22-183	-		12
General Chemistry - Westborough Lab Associated sample(s): 01-03 QC Batch ID: WG1178627-4 QC Sample: L1845199-01 Client ID: BH-1, 2D, 2-4'												
Chloride	ND	430	460	106		-	-		62-129	-		35

Lab Duplicate Analysis
Batch Quality Control

Project Name: NECEC, KRC
Project Number: 18-0345

Lab Number: L1845199
Report Date: 11/14/18

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-03 QC Batch ID: WG1176408-1 QC Sample: L1845199-01 Client ID: BH-1, 2D, 2-4'						
Solids, Total	92.2	92.4	%	0		20
Moisture	7.8	7.60	%	3		20
General Chemistry - Westborough Lab Associated sample(s): 01-03 QC Batch ID: WG1176501-2 QC Sample: L1845199-01 Client ID: BH-1, 2D, 2-4'						
pH (H)	6.0	6.0	SU	0		5
General Chemistry - Westborough Lab Associated sample(s): 01-03 QC Batch ID: WG1178627-3 QC Sample: L1845199-01 Client ID: BH-1, 2D, 2-4'						
Chloride	ND	ND	mg/kg	NC		35

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Present/Intact

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L1845199-01A	Glass 250ml/8oz unpreserved	A	NA		2.9	Y	Present/Intact		CL-9251(28),SO4-9038(28),PH-9045(1),ME-TS-2540(7),MOISTURE(7)
L1845199-02A	Glass 250ml/8oz unpreserved	A	NA		2.9	Y	Present/Intact		CL-9251(28),SO4-9038(28),PH-9045(1),ME-TS-2540(7),MOISTURE(7)
L1845199-03A	Glass 250ml/8oz unpreserved	A	NA		2.9	Y	Present/Intact		CL-9251(28),SO4-9038(28),PH-9045(1),ME-TS-2540(7),MOISTURE(7)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EMPC	- Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TEF	- Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.
TEQ	- Toxic Equivalent: The measure of a sample¿s toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Footnotes

1	- The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Report Format: Data Usability Report

Data Qualifiers

A	- Spectra identified as "Aldol Condensation Product".
B	- The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).
C	- Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.
D	- Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
E	- Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
G	- The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.
H	- The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
I	- The lower value for the two columns has been reported due to obvious interference.
M	- Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.
NJ	- Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
P	- The RPD between the results for the two columns exceeds the method-specified criteria.
Q	- The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
R	- Analytical results are from sample re-analysis.
RE	- Analytical results are from sample re-extraction.
S	- Analytical results are from modified screening analysis.
J	- Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
ND	- Not detected at the reporting limit (RL) for the sample.

Report Format: Data Usability Report

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IV, 2007.

121 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WEF. Standard Methods Online.

LIMITATION OF LIABILITIES

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility
EPA 624/624.1: m/p-xylene, o-xylene
EPA 8260C: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), Methyl methacrylate, 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.
EPA 8270D: NPW: Dimethylnaphthalene,1,4-Diphenylhydrazine; SCM: Dimethylnaphthalene,1,4-Diphenylhydrazine.

EPA 6860: SCM: Perchlorate

SM4500: NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
SM 2540D: TSS
EPA 8082A: NPW: PCB: 1, 5, 31, 87,101, 110, 141, 151, 153, 180, 183, 187.
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.
Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water
EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B**
EPA 332: Perchlorate; **EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT,SM9222D**.

Non-Potable Water
SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2**: Nitrate-N**, SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300: Chloride, Sulfate, Nitrate.**
EPA 624.1: Volatile Halocarbons & Aromatics,
EPA 608.3: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625.1: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9221E, EPA 1600, EPA 1603.**

Mansfield Facility:

Drinking Water
EPA 200.7: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.
EPA 522.

Non-Potable Water
EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.
EPA 200.8: Al, Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.
EPA 245.1 Hg.
SM2340B

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

CHAIN OF CUSTODY

PAGE 1 OF 1

Date Rec'd in Lab: 11/05/18

ALPHA Job #: L1845199

ALPHA ANALYTICAL
8 Walkup Drive, Westboro, MA 01581, Tel: 508-898-9220
320 Forbes Blvd, Mansfield, MA 02048, Tel: 508-822-9300

Project Information

Project Name: NECEC KRC
Project Location: West Forks Plantation, ME
Project #: 18-0345
Project Manager: Paul Kohler
ALPHA Quote #:

Report Information - Data Deliverables

☐ ADEx ☑ EMAIL

Billing Information

☑ Same as Client info | PO #:

Client Information

Client: S.W. Cole Engineering, Inc.
Address: 37 Liberty Drive, Hermon, ME
Phone: 207-848-5714
Email: Nate.Stret@swcole.com ↳ PKohler@swcole.com

Regulatory Requirements & Project Information Requirements

☐ Yes ☐ No MA MCP Analytical Methods ☐ Yes ☐ No CT RCP Analytical Methods
☐ Yes ☐ No Matrix Spike Required on this SDG? (Required for MCP Inorganics)
☐ Yes ☐ No GW1 Standards (Info Required for Metals & EPH with Targets)
☐ Yes ☐ No NPDES RGP
☐ Other State /Fed Program ______ Criteria ______

Turn-Around Time

☑ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due:

Additional Project Information:

ANALYSIS

VOC: ☐ 8260 ☐ 624 ☐ 524.2
SVOC: ☐ ABN ☐ PAH
METALS: ☐ MCP 13 ☐ MCP 14 ☐ RCP 15
METALS: ☐ RCRA5 ☐ RCRA8 ☐ PP13
EPH: ☐ Ranges & Targets ☐ Ranges Only
VPH: ☐ Ranges & Targets ☐ Ranges Only
☐ PCB ☐ PEST
TPH: ☐ Quant Only ☐ Fingerprint

SAMPLE INFO
Filtration: ☐ Field ☐ Lab to do
Preservation: ☐ Lab to do

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler Initials	Sulfate - 9038	Chloride - 9251	pH - 9045	moisture content	Sample Comments	TOTAL # BOTTLES
45199-01	BH-1, 2D, 2-4'	10-30-18	16:00	Soil	NDS	✓	✓	✓	✓		
02	BH-2, 1D, 0.4-2'	10-30-18	14:45	soil	NDS	✓	✓	✓	✓		
03	BH-5, 3D, 5-7'	11-2-18	15:15	soil	NDS	✓	✓	✓	✓		

	Sulfate	Chloride	pH
Container Type	6	6	6
Preservative	A	A	A

Container Type: P= Plastic, A= Amber glass, V= Vial, G= Glass, B= Bacteria cup, C= Cube, O= Other, E= Encore, D= BOD Bottle

Preservative: A= None, B= HCl, C= HNO_3, D= H_2SO_4, E= NaOH, F= MeOH, G= $NaHSO_4$, H = $Na_2S_2O_3$, I= Ascorbic Acid, J = NH_4Cl, K= Zn Acetate, O= Other

Relinquished By:	Date/Time	Received By:	Date/Time
Stormy Wardwell	15:22 11/5/18	Dennis Alley Dol	11/5/18 1532
Dennis B. Alley		[signature]	11/5/18 23:23

All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 12-Mar-2012)

UNISHIP
COURIER SERVICES LLC

Bill Shipping Charge to

Shipper ☐ Recipient ☐ ☐ Next Day ☐ Same Day

052018

Special ____

10 Iron Road
Hermon, Maine 04401
Phone 207•348•7546 ■ Toll-Free 800•427•7547 ■ Fax 207•561•2467
390 US Route One, #3
Falmouth, Maine 04105

FROM:		TO:	
Shipper	Alpha	Recipient	Alpha
Street		Street	8 Walker Drive
Origin	Brewer [illegible] Zip Code	Destination	[illegible] Zip Code
Phone #		Phone #	

No. Pieces	Weight Each	Description of Items	Total Weight (Subject to Correction)	Oversize Charge	Shipping Charges
1		1 cooler [illegible]			
	TOTAL PIECES	WEIGHT GRAND TOTAL		TOTAL CHARGES	

Shipper authorizes Uniship to deliver this shipment without obtaining a delivery signature.

Shipper's Signature [illegible]

Please use complete ship to address.
Uniship can not deliver to P.O. Boxes.

RECEIVED, subject to the classifications and tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property, under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property overall or any portion of said route to destination and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the bill of lading terms and conditions in the governing classification on the date of shipment.

Shipper hereby certifies that he is familiar with all the bill of lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

SHIPPER		PICK-UP TIME	18:10	RECIPIENT	[illegible]	DELIVERY TIME	[illegible]
COURIER SIGNATURE	[illegible]	DATE	11-5-2018	COURIER SIGNATURE	[illegible]	DATE	[illegible]

RECIPIENT COPY


SCI SPEC
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PRECLEANED CONTAINERS
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SIGNATURE
scispec.com
C20000

ANALYTICAL REPORT

Lab Number:	L1849289
Client:	S. W. Cole Engineering, Inc. 37 Liberty Drive Bangor, ME 04401-5784
ATTN:	Nate Strout
Phone:	(207) 657-2866
Project Name:	NECEC, KRC
Project Number:	18-0345
Report Date:	12/10/18

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0574), IL (200077), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #P330-17-00196).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: NECEC, KRC
Project Number: 18-0345

Lab Number: L1849289
Report Date: 12/10/18

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1849289-01	BH-3, S-1, 2-5'	SOIL	MOXIE GORE, ME	11/26/18 12:30	12/03/18

Project Name:	NECEC, KRC	**Lab Number:**	L1849289
Project Number:	18-0345	**Report Date:**	12/10/18

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. All specific QC information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY
For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Kelly Stenstrom

Title: Technical Director/Representative

Date: 12/10/18

INORGANICS
&
MISCELLANEOUS

Project Name:	NECEC, KRC	**Lab Number:**	L1849289
Project Number:	18-0345	**Report Date:**	12/10/18

SAMPLE RESULTS

Lab ID:	L1849289-01	Date Collected:	11/26/18 12:30
Client ID:	BH-3, S-1, 2-5'	Date Received:	12/03/18
Sample Location:	MOXIE GORE, ME	Field Prep:	Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	87.7		%	0.100	NA	1	-	12/06/18 10:54	121,2540G	RI
Chloride	22		mg/kg	11	--	1	-	12/05/18 23:19	1,9251	TL
pH (H)	5.3		SU	-	NA	1	-	12/04/18 18:32	1,9045D	AS
Sulfate	ND		mg/kg	110	--	1	-	12/04/18 22:10	1,9038	BR

Project Name:	NECEC, KRC	**Lab Number:**	L1849289
Project Number:	18-0345	**Report Date:**	12/10/18

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01 Batch: WG1185515-1										
Sulfate	ND		mg/kg	100	--	1	-	12/04/18 22:10	1,9038	BR
General Chemistry - Westborough Lab for sample(s): 01 Batch: WG1186007-1										
Chloride	ND		mg/kg	10	--	1	-	12/05/18 21:48	1,9251	TL

Lab Control Sample Analysis
Batch Quality Control

Project Name: NECEC, KRC
Project Number: 18-0345

Lab Number: L1849289
Report Date: 12/10/18

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01 Batch: WG1185515-2								
Sulfate	95		-		80-121	-		12
General Chemistry - Westborough Lab Associated sample(s): 01 Batch: WG1185563-1								
pH	100		-		99-101	-		
General Chemistry - Westborough Lab Associated sample(s): 01 Batch: WG1186007-2								
Chloride	101		-		89-109	-		35

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
B	Present/Intact

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L1849289-01A	Glass 250ml/8oz unpreserved	B	NA		4.7	Y	Present/Intact		CL-9251(28),SO4-9038(28),PH-9045(1),ME-TS-2540(7)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

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1	- The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Report Format: Data Usability Report

Project Name: NECEC, KRC **Lab Number:** L1849289
Project Number: 18-0345 **Report Date:** 12/10/18

Data Qualifiers

A - Spectra identified as "Aldol Condensation Product".

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The lower value for the two columns has been reported due to obvious interference.

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

S - Analytical results are from modified screening analysis.

J - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

ND - Not detected at the reporting limit (RL) for the sample.

Report Format: Data Usability Report

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IV, 2007.

121 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WEF. Standard Methods Online.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility
EPA 624/624.1: m/p-xylene, o-xylene
EPA 8260C: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), Methyl methacrylate, 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.
EPA 8270D: NPW: Dimethylnaphthalene,1,4-Diphenylhydrazine; SCM: Dimethylnaphthalene,1,4-Diphenylhydrazine.

EPA 6860: SCM: Perchlorate

SM4500: NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
SM 2540D: TSS
EPA 8082A: NPW: PCB: 1, 5, 31, 87,101, 110, 141, 151, 153, 180, 183, 187.
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.
Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water
EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B**
EPA 332: Perchlorate; **EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT,SM9222D**.

Non-Potable Water
SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2**: Nitrate-N**, SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300: Chloride, Sulfate, Nitrate.**
EPA 624.1: Volatile Halocarbons & Aromatics,
EPA 608.3: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625.1: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9221E, EPA 1600, EPA 1603.**

Mansfield Facility:

Drinking Water
EPA 200.7: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.
EPA 522.

Non-Potable Water
EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.
EPA 200.8: Al, Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.
EPA 245.1 Hg.
SM2340B

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

CHAIN OF CUSTODY

PAGE 1 OF 1

Date Rec'd in Lab: 12/3/18

ALPHA Job #: L1849289

ALPHA ANALYTICAL
8 Walkup Drive, Westboro, MA 01581, Tel: 508-898-9220
320 Forbes Blvd, Mansfield, MA 02048, Tel: 508-822-9300

Client Information

Client: S.W. Cole Engineering, Inc.
Address: 37 Liberty Dr, Hermon, ME
Phone: 207-848-5714
Email: Nate Stout @ swcole.com

Project Information

Project Name: NECEC, KRC
Project Location: Moxie Gore, ME
Project #: 18-0345
Project Manager: Paul Kohler
ALPHA Quote #: ↳ PKohler@swcole.com

Turn-Around Time

☑ Standard ☐ RUSH (only confirmed if pre-approved)

Date Due:

Additional Project Information:

Report Information - Data Deliverables

☐ ADEx ☑ EMAIL

Billing Information

☑ Same as Client info PO #:

Regulatory Requirements & Project Information Requirements

☐ Yes ☐ No MA MCP Analytical Methods ☐ Yes ☐ No CT RCP Analytical Methods
☐ Yes ☐ No Matrix Spike Required on this SDG? (Required for MCP Inorganics)
☐ Yes ☐ No GW1 Standards (Info Required for Metals & EPH with Targets)
☐ Yes ☐ No NPDES RGP
☐ Other State /Fed Program ______ Criteria ______

ANALYSIS

VOC: ☐ 8260 ☐ 624 ☐ 524.2; SVOC: ☐ ABN ☐ PAH; METALS: ☐ MCP 13 ☐ MCP 14 ☐ RCP 15; METALS: ☐ RCRA5 ☐ RCRA8 ☐ PP13; EPH: ☐ Ranges & Targets ☐ Ranges Only; VPH: ☐ Ranges & Targets ☐ Ranges Only; ☐ PCB ☐ PEST; TPH: ☐ Quant Only ☐ Fingerprint; Sulfate - 9038; Chloride - 9251; pH - 9045

SAMPLE INFO
Filtration
☐ Field
☐ Lab to do
Preservation
☐ Lab to do

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler Initials	Sulfate - 9038	Chloride - 9251	pH - 9045	Sample Comments	TOTAL # BOTTLES
49289 -01	BH-3, S-1, 2-5'	11-26-18	12:30	Soil	KH	✓	✓	✓		
Container Type						6	6	6		
Preservative						A	A	A		

Container Type
P= Plastic
A= Amber glass
V= Vial
G= Glass
B= Bacteria cup
C= Cube
O= Other
E= Encore
D= BOD Bottle

Preservative
A= None
B= HCl
C= HNO_3
D= H_2SO_4
E= NaOH
F= MeOH
G= $NaHSO_4$
H = $Na_2S_2O_3$
I= Ascorbic Acid
J = NH_4Cl
K= Zn Acetate
O= Other

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	12-3-18/1530	[signature]	12-3-18/1530
[signature]	12-3-18/1530	[signature] AAL	12/3/18 15:30
[signature] AAL		Danielle Matt	12/3/18 23:20

UNISHIP
COURIER SERVICES LLC
10 Iron Road
Hermon, Maine 04401
Phone 207•848•7546 ■ Toll-Free 800•427•7547 ■ Fax 207•561•2467
390 US Route One, #3
Falmouth, Maine 04105

Bill Shipping Charge to

Shipper ☐ Recipient ☐ ☐ Next Day ☐ Same Day

Special ____________

043251

FROM:		TO:	
Shipper	Alpha	Recipient	Alpha
Street	[illegible] Center St	Street	[illegible]
Origin	Brewer ME Zip Code	Destination	[illegible] ME Zip Code
Phone #		Phone #	

No. Pieces	Weight Each	Description of Items	Total Weight (Subject to Correction)	Oversize Charge	Shipping Charges
4		1 [illegible]			
		2 [illegible]			
		1 [illegible]			
◄ TOTAL PIECES		WEIGHT GRAND TOTAL ►		TOTAL CHARGES ►	

Shipper authorizes Uniship to deliver this shipment without obtaining a delivery signature.

Shipper's Signature [illegible]

Please use complete ship to address.
Uniship can not deliver to P.O. Boxes.

RECEIVED, subject to the classifications and tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property, under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property overall or any portion of said route to destination and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the bill of lading terms and conditions in the governing classification on the date of shipment.
Shipper hereby certifies that he is familiar with all the bill of lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

SHIPPER		PICK-UP TIME	17:41	RECIPIENT [illegible]	DELIVERY TIME [illegible]
COURIER SIGNATURE	CW	DATE	12-7-18	COURIER SIGNATURE [illegible]	DATE 12-?-18

RECIPIENT COPY


SCI SPEC
PRECLEANED CONTAINERS
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Custody Seal Custody Seal Custody Seal Custody Seal
DATE
SIGNATURE
scispec.com
C20000

Cooler B

ANALYTICAL REPORT

Lab Number:	L1846610
Client:	S. W. Cole Engineering, Inc. 37 Liberty Drive Bangor, ME 04401-5784
ATTN:	Nate Strout
Phone:	(207) 657-2866
Project Name:	NECEC-KRC
Project Number:	18-0345
Report Date:	11/21/18

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0574), IL (200077), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #P330-17-00196).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: NECEC-KRC
Project Number: 18-0345

Lab Number: L1846610
Report Date: 11/21/18

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1846610-01	BH-4, S-1, 1.0-2.5'	SOIL	MOXIE GORE, ME	11/08/18 11:00	11/14/18

Project Name:	NECEC-KRC	**Lab Number:**	L1846610
Project Number:	18-0345	**Report Date:**	11/21/18

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. All specific QC information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY
For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Kelly Stenstrom Kelly Stenstrom

Title: Technical Director/Representative Date: 11/21/18

INORGANICS
&
MISCELLANEOUS

Project Name: NECEC-KRC **Lab Number:** L1846610
Project Number: 18-0345 **Report Date:** 11/21/18

SAMPLE RESULTS

Lab ID: L1846610-01
Client ID: BH-4, S-1, 1.0-2.5'
Sample Location: MOXIE GORE, ME

Date Collected: 11/08/18 11:00
Date Received: 11/14/18
Field Prep: Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	84.7		%	0.100	NA	1	-	11/15/18 10:23	121,2540G	RI
Chloride	ND		mg/kg	11	--	1	-	11/19/18 18:46	1,9251	ML
pH (H)	7.0		SU	-	NA	1	-	11/15/18 18:10	1,9045D	AS
Sulfate	ND		mg/kg	120	--	1	-	11/21/18 12:01	1,9038	BR
Moisture	15.3		%	0.100	NA	1	-	11/15/18 10:23	121,2540G	RI

Project Name: NECEC-KRC **Lab Number:** L1846610
Project Number: 18-0345 **Report Date:** 11/21/18

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01 Batch: WG1181067-1										
Chloride	ND		mg/kg	10	--	1	-	11/19/18 18:44	1,9251	ML
General Chemistry - Westborough Lab for sample(s): 01 Batch: WG1181525-1										
Sulfate	ND		mg/kg	100	--	1	-	11/21/18 12:01	1,9038	BR

Lab Control Sample Analysis
Batch Quality Control

Project Name: NECEC-KRC
Project Number: 18-0345

Lab Number: L1846610
Report Date: 11/21/18

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01 Batch: WG1179936-1								
pH	100		-		99-101	-		
General Chemistry - Westborough Lab Associated sample(s): 01 Batch: WG1181067-2								
Chloride	104		-		89-109	-		35
General Chemistry - Westborough Lab Associated sample(s): 01 Batch: WG1181525-2								
Sulfate	102		-		80-121	-		12

Matrix Spike Analysis
Batch Quality Control

Project Name: NECEC-KRC
Project Number: 18-0345

Lab Number: L1846610
Report Date: 11/21/18

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01 QC Batch ID: WG1181067-4 QC Sample: L1846610-01 Client ID: BH-4, S-1, 1.0-2.5'												
Chloride	ND	451	460	102		-	-		62-129	-		35
General Chemistry - Westborough Lab Associated sample(s): 01 QC Batch ID: WG1181525-4 QC Sample: L1846610-01 Client ID: BH-4, S-1, 1.0-2.5'												
Sulfate	ND	223	170	76		-	-		22-183	-		12

Lab Duplicate Analysis
Batch Quality Control

Project Name: NECEC-KRC
Project Number: 18-0345

Lab Number: L1846610
Report Date: 11/21/18

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01 QC Batch ID: WG1179774-1 QC Sample: L1846610-01 Client ID: BH-4, S-1, 1.0-2.5'						
Solids, Total	84.7	82.4	%	3		20
Moisture	15.3	17.6	%	14		20
General Chemistry - Westborough Lab Associated sample(s): 01 QC Batch ID: WG1181067-3 QC Sample: L1846610-01 Client ID: BH-4, S-1, 1.0-2.5'						
Chloride	ND	ND	mg/kg	NC		35
General Chemistry - Westborough Lab Associated sample(s): 01 QC Batch ID: WG1181525-3 QC Sample: L1846610-01 Client ID: BH-4, S-1, 1.0-2.5'						
Sulfate	ND	ND	mg/kg	NC		12

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Present/Intact

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L1846610-01A	Glass 250ml/8oz unpreserved	A	NA		2.7	Y	Present/Intact		CL-9251(28),SO4-9038(28),PH-9045(1),ME-TS-2540(7),MOISTURE(7)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EMPC	- Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TEF	- Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.
TEQ	- Toxic Equivalent: The measure of a sample¿s toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Footnotes

1	- The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Report Format: Data Usability Report

Project Name: NECEC-KRC **Lab Number:** L1846610
Project Number: 18-0345 **Report Date:** 11/21/18

Data Qualifiers

A - Spectra identified as "Aldol Condensation Product".

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The lower value for the two columns has been reported due to obvious interference.

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

S - Analytical results are from modified screening analysis.

J - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

ND - Not detected at the reporting limit (RL) for the sample.

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IV, 2007.

121 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WEF. Standard Methods Online.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility
EPA 624/624.1: m/p-xylene, o-xylene
EPA 8260C: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), Methyl methacrylate, 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.
EPA 8270D: NPW: Dimethylnaphthalene,1,4-Diphenylhydrazine; SCM: Dimethylnaphthalene,1,4-Diphenylhydrazine.

EPA 6860: SCM: Perchlorate

SM4500: NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
SM 2540D: TSS
EPA 8082A: NPW: PCB: 1, 5, 31, 87,101, 110, 141, 151, 153, 180, 183, 187.
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.
Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water
EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B**
EPA 332: Perchlorate; **EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT,SM9222D**.

Non-Potable Water
SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2**: Nitrate-N**, SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300: Chloride, Sulfate, Nitrate.**
EPA 624.1: Volatile Halocarbons & Aromatics,
EPA 608.3: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625.1: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9221E, EPA 1600, EPA 1603.**

Mansfield Facility:

Drinking Water
EPA 200.7: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.
EPA 522.

Non-Potable Water
EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.
EPA 200.8: Al, Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.
EPA 245.1 Hg.
SM2340B

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

CHAIN OF CUSTODY

PAGE 1 OF 1

Date Rec'd in Lab: 11/14/18

ALPHA Job #: L1846610

ALPHA ANALYTICAL
8 Walkup Drive, Westboro, MA 01581, Tel: 508-898-9220
320 Forbes Blvd, Mansfield, MA 02048, Tel: 508-822-9300

Project Information

Project Name: NECEC- KRC
Project Location: Moxie Gore, ME
Project #: 18-0375
Project Manager: Paul Kohler
ALPHA Quote #: ↳ PKohler@swcole.com

Report Information - Data Deliverables

☐ ADEx ☑ EMAIL

Billing Information

☑ Same as Client info PO #:

Client Information

Client: S.W. Cole Engineering Inc.
Address: 37 Liberty Drive, Hermon, ME
Phone: 207-848-5714
Email: Nate.Street@swcole.com

Regulatory Requirements & Project Information Requirements

☐ Yes ☐ No MA MCP Analytical Methods ☐ Yes ☐ No CT RCP Analytical Methods
☐ Yes ☐ No Matrix Spike Required on this SDG? (Required for MCP Inorganics)
☐ Yes ☐ No GW1 Standards (Info Required for Metals & EPH with Targets)
☐ Yes ☐ No NPDES RGP
☐ Other State /Fed Program ______ Criteria ______

Turn-Around Time

☑ Standard ☐ RUSH (only confirmed if pre-approved)

Date Due:

Additional Project Information:

ANALYSIS

VOC: ☐ 8260 ☐ 624 ☐ 524.2
SVOC: ☐ ABN ☐ PAH
METALS: ☐ MCP 13 ☐ MCP 14 ☐ RCP 15
METALS: ☐ RCRA5 ☐ RCRA8 ☐ PP13
EPH: ☐ Ranges & Targets ☐ Ranges Only
VPH: ☐ Ranges & Targets ☐ Ranges Only
☐ PCB ☐ PEST
TPH: ☐ Quant Only ☐ Fingerprint
Sulfate - 9038
Chloride - 9251
pH - 9045
Moisture content

SAMPLE INFO
Filtration ☐ Field ☐ Lab to do
Preservation ☐ Lab to do

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler Initials	Sulfate - 9038	Chloride - 9251	pH - 9045	Moisture content	Sample Comments	TOTAL # BOTTLES
46610-01	BH-4, S-1, 1.0-2.5'	11-8-18	11:00	Soil	NDS	✓	✓	✓	✓		

	Sulfate - 9038	Chloride - 9251	pH - 9045	Moisture content
Container Type	G	G	G	G
Preservative	A	A	A	A

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	11-14-18/1100	[signature] AAL	11/14/18 1100
[signature]		[signature]	11/14/18 2350

Container Type: P= Plastic, A= Amber glass, V= Vial, G= Glass, B= Bacteria cup, C= Cube, O= Other, E= Encore, D= BOD Bottle

Preservative: A= None, B= HCl, C= HNO_3, D= H_2SO_4, E= NaOH, F= MeOH, G= $NaHSO_4$, H = $Na_2S_2O_3$, I= Ascorbic Acid, J = NH_4Cl, K= Zn Acetate, O= Other


SCI SPEC
PRECLEANED CONTAINERS
Committed to Quality Since 196
Custody Seal Custody Seal Custody Seal Custody Seal
DATE
SIGNATURE
scispec.com
SCI SPEC
PRECLEANED CONTAINERS
C20000
Committed to Quality Since 1963

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COURIER SERVICES LLC

10 Iron Road
Hermon, Maine 04401

Bill Shipping Charge to

Shipper ☐ Recipient ☐
☐ Next Day ☐ Same Day

Special ____________

047216

390 US Route One, #3
Falmouth, Maine 04105

Phone 207•848•7546 ■ Toll-Free 800•427•7547 ■ Fax 207•561•2467

FROM: Shipper Alpha
Street
Origin Brewer ME Zip Code
Phone #

TO: Recipient Alpha
Street 8 Walton Drive
Destination Westbrook ME Zip Code
Phone #

No. Pieces	Weight Each	Description of Items	Total Weight (Subject to Correction)	Oversize Charge	Shipping Charges
5		1 cooler Tasman			
		1 cooler Chr role			
		1 cooler CES			
		1 cooler Environmental Restoration			
		1 cooler ME NEP			
	TOTAL PIECES	WEIGHT GRAND TOTAL		TOTAL CHARGES	

Shipper authorizes Uniship to deliver this shipment without obtaining a delivery signature.
Shipper's Signature [signature]

Please use complete ship to address.
Uniship can not deliver to P.O. Boxes.

RECEIVED, subject to the classifications and tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property, under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property overall or any portion of said route to destination and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the bill of lading terms and conditions in the governing classification on the date of shipment.
Shipper hereby certifies that he is familiar with all the bill of lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

SHIPPER	PICK-UP TIME 1800	RECIPIENT	DELIVERY TIME
COURIER SIGNATURE [signature]	DATE 11/14/18	COURIER SIGNATURE [signature]	DATE

RECIPIENT COPY

Exhibit G-4: HDD Geotechnical Feasibility Memo

TRC
Results you can rely on
249 Western Avenue
Augusta, ME 04330
207.621.7000 PHONE
207.621.7001 FAX
www.trcsolutions.com

Sent Via ProjectWise

October 17, 2018

Adam Desrosiers
Program Manager – NECEC Project
83 Edison Dr.
Augusta, ME 04336

RE: NECEC Kennebec River Crossing – HDD Conceptual Design
Geotechnical Feasibility Review
TRC Job No. 315641

Dear Mr. Desrosiers,

TRC is pleased to provide Avangrid (CMP) with the following information regarding the geotechnical feasibility of the proposed NECEC Kennebec River crossing. This review was performed to assess the suitability of using Horizontal Directional Drilling (HDD) for the Kennebec River crossing from the eastern termination station located in Moxie Gore, Somerset County, Maine to the western termination station in West Forks Plantation, Somerset County, Maine.

Bedrock Geology

According to the geologic map for the area[1], the project site is generally underlain by Devonian, massive, dark gray slate of the Carrabassett Formation. This slate may locally contain alternating thin beds of graywacke and pelite. The slate is steeply dipping (dip from 53° to 89°) with the bedding planes orientation (strike) approximately southwest to northeast.

The geologic map for the area indicates the easternmost portion of the crossing area may be underlain by Silurian, thinly bedded, gray-brown, dolostone, limestone, and calcareous siltstone of the Forks Formation, which grades upward into variegated, medium bedded, calcareous sandstone and phyllite. Silurian volcanic rock may be encountered near the contact with the Carrabassett Formation.

A copy of the bedrock geology map is included as an attachment.

1 Burroughs, W. and Marvinney, R.G., 1981, *Reconnaissance Bedrock Geology of the Forks Quadrangle, Maine*, Open File No. 81-10, Maine Geological Survey, Department of Conservation.

Surficial Materials Geology

The surficial materials at site appear to be soils of the Monson-Elliottsville-Knob Lock (MEK) complex or the Danforth-Elliottsville (DE) association[2]. Soils in the MEK complex are generally clayey silts with sand and the underlying bedrock is fairly shallow (i.e. two to seven feet below the ground surface). Soils in the DE association are generally gravelly, sandy silt or gravelly, silty sand and the underlying bedrock is expected to be more than seven feet below the ground surface.

Within the Kennebec River, the surficial materials are expected to consist of coarse sand to boulders. Based on observations from aerial photographs of the area, this stretch of the river is rapids, so surficial materials are expected to be less than five to ten feet beneath the water surface and the bedrock is expected to be fairly shallow.

Rock Mechanical Classification for HDD

When considering the overall effect on the drillability of bedrock, the following rock characteristics are considered to be important in understanding the feasibility of HDD:

- Hardness
- Abrasiveness
- Texture
- Structure
- Breaking characteristics

These characteristics are typically determined from the following rock properties obtained in a geotechnical investigation:

- Rock Quality Designation (RQD) – correlates with abrasiveness, texture, structure, and breaking characteristics,
- Core Run Percent Recovery – correlates with texture, structure, and breaking characteristics,
- Unconfined Compressive Strength (UCS) – correlates with texture and breaking characteristics, and
- Mohs Hardness – correlates with hardness and abrasiveness.

Although UCS values for bedrock in the Carrabassett and Forks Formations was not available, typical values for similar rocks in Vermont[3] indicate that the UCS will be in the range of 4,000 to 10,500 pounds per square inch (psi), with the expected UCS to be about 6,000 to 8,000 psi.

Based on past experience with similar formations, the RQD and core recovery have been in the range of 50% to 80% and 12 to 50 inches, respectively, for NQ or NX rock cores (approximately 2 inches in diameter) obtained with a five-foot long core barrel.

---

2 NRCS. 2018. Soil Map—Somerset County Area and Parts of Franklin and Oxford Counties, Maine, Web Soil Survey National Cooperative Soil Survey, U.S. Department of Agriculture, Natural Resources Conservation Service

3 Thomas, E.J. and Eliassen, T.D. 2015. *Unconfined Compressive Strengths of Vermont Rock, State of Vermont*, Agency of Transportation, Construction and Materials Bureau, Geotechnical Engineering Division.

The majority of rock in the Carrabassett and Forks Formations is expected to be relatively unweathered and the hardness is expected to be moderately soft to hard.

Based on the estimated rock properties and characteristics for the bedrock that will be encountered by HDD for the Kennebec River crossing, HDD appears to be feasible. However, Maine Directional Boring Contractors notes on their website that a tricone bit may be required to drill through the bedrock[4].

HDD in Maine

An internet search identified several HDD contractors in New England, including contractors in Maine. Their websites indicate that they have experience performing HDD in Maine's geology and with HDD through bedrock in particular.

These firms include:

- Enterprise Trenchless Technologies, Inc.
- Maine Boring Contractors
- Henniker Directional Drilling, LLC
- Northeast Directional Drilling.

Conclusions

Based on our review of the available information regarding the geology of the NECEC Kennebec River crossing site, HDD appears to be a feasible technology for the installation of the power transmission lines under the river. Although the surficial and bedrock geology do not appear to impose constraints on using HDD, site-specific information regarding the soils and, especially, the underlying bedrock at the site will need to be obtained. Therefore, a suitable geotechnical investigation, including borings with rock cores adjacent to the proposed HDD alignment, should be conducted and testing of the rock materials should be performed. In this investigation, rock coring should be conducted to a depth of at least 20 feet below the depth of the alignment to properly characterize the bedrock.

We sincerely appreciate this opportunity and hope the information provided herein is in line with your expectations. Should you have any questions regarding this information, please feel free to contact me at (207) 620-3886 or via email at wnarinvancourt@trcsolutions.com.

Sincerely,

Wade A. Narin van Court, PhD, PE
Geotechnical Engineer

Attachments:
Reconnaissance Bedrock Geology of the Forks Quadrangle, Maine

4 http://maineboringcontractors.com/services/hard-rock-maine-directional-boring/

EXPLANATION

STRATIFIED ROCKS

LOWER DEVONIAN

Dto / Dtokg

TOMHEGAN FORMATION (Dto)

Gray-weathering and rusty-weathering dark sandstone.

Kineo Volcanic Member (Dtokm)

Massive felsite.

UNCONFORMITY ?

Dtm / Dt

TARRATINE FORMATION (Dt)

Dark Sandstone.

Misery Quartzite Member (Dtm)

Gray quartzite and dark sandstone.

Ds

SEBOOMOOK FORMATION (Ds)

Cyclically-banded argillite.

Dp

DEVONIAN PELLITE, UNDIFFERENTIATED (Dp)

Dark-gray slate with thin beds of siltstone and fine sandstone.

UNCONFORMITY ?

Dh

HILDRETHS FORMATION (Dh)

Rusty-weathering, thinly bedded, calcareous, sulfidic slate, locally graphitic; sulfidic, laminated, calc-silicate and pelitic schist where contact metamorphosed.

Dc

CARRABASSETT FORMATION (Dc)

Massive, dark-gray slate, locally containing at its base graded sections of alternating thin beds of graywacke and pelite.

UNCONFORMITY ?

SILURIAN

Stf

THE FORKS FORMATION (Stf)

Thinly bedded gray-brown dolostone, limestone, and calcareous siltstone grading upward into variegated, medium-bedded, brown and light-gray calcareous sandstone and phyllite.

Su

SILURIAN UNDIFFERENTIATED (Su)

Calcareous slate, limestone conglomerate, and limestone.

UNCONFORMITY ?

CAMBRIAN (?) AND ORDOVICIAN (?)

O€dr / O€drd / O€drc / O€drb / O€dra

DEAD RIVER FORMATION, UNDIFFERENTIATED (O€dr)

Predominantly greenish-gray slate and phyllite with minor thin- to medium-bedded, discontinuous layers of metasiltstone to very fine subarkosewacke.

"Middle" Member (O€drd)

Light-green, mica-pinstriped, medium-bedded metasiltstone layers and and zones of thinly bedded metasiltstone laminae and quartzofelspathic veins in greenish-gray phyllite.

Charcoal-gray Slate Lithotype (O€drc)

Non-rusty, dark charcoal-gray slate and phyllite.

Gray Slate Lithotype (O€drb)

Silvery gray slate and phyllite.

Interlayered Blue and Green Slate Lithotype (O€dra)

Interlayered green, blue, and maroon slate and phyllite.

O€hm / O€px

HURRICANE MOUNTAIN FORMATION (O€hm)

Rusty-weathering, black sulfidic slate and medium-bedded, dark-gray metasiltstone, in places containing exotic blocks of meta-quartzite, amphibolite, and orthopyroxenite (O€px).

O€qw / O€s

QUARTZWACKE (O€qw)

Poorly sorted, light-gray, feldspathic metaquartzwacke, metasiltstone, and granule metaconglomerate containing clasts of dark quartz; generally massively bedded with some graded horizons and small lenses of interlayered black and green slate.

Slate (O€s)

Exceptionally well-cleaved, silvery-gray and rare, reddish slate.

IGNEOUS ROCKS

g

GARNET RHYOLITE (g)

Dg

DIORITE AND GABBRO, UNDIFFERENTIATED (Dg)

Dmp / Dmpu / Dmpt / Dmpa / s Dmpu / s Dmpt

MOXIE PLUTON, UNDIFFERENTIATED (Dmp)

Troctolite, norite, and gabbro.

Ultramafic Rock (Dmpu)

Olivine cumulate locally containing bronzite cumulate layers.

Troctolite (Dmpt)

Olivine plagioclase cumulate.

Olivine gabbro (Dmpa)

Olivine gabbro altered to amphibole-plagioclase; locally foliated.

Sulfidic Rocks (Dmpu (s)/Dmpt(s))

Cumulate rocks containing 5-20% interstitial sulfide.

Dqm

Quartz Monzonite (Dqm)

Sv

Silurian volcanics

O€fp

Felsite porphyry

O€f

Felsite

SYMBOLS

Contact. Dashed where approximately located; queried where probable. Heavy line where located by field mapping, this survey; light line where compiled from previous maps.

Fault. Dashed where approximately located; queried where probable. U, upthrown; D, downthrown side. Balls on upper plate of reverse fault. Arrows show sense of apparent offset along strike-slip fault.

Outcrop control. Other outcrops where no structural data are reported.

Contact metamorphic aureole.

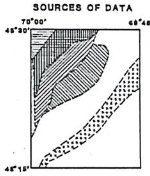
Approximate position of andalusite isograd in Moxie Pluton contact aureole.

Dip and Strike

(Inclined)	(Vertical)	
35		of beds
76		of beds, facing known (ball indicates tops)
53		of overturned beds
11		of early foliation, origin unknown
85		of cleavage
16		of late shears

Minor fold plunge (angle where known) and form.

SOURCES OF DATA



Field survey, 1980 by W. Burroughs.

Field survey, 1979-1980, by R. Marvinney.

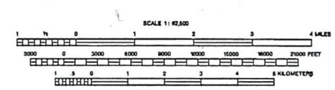
Field survey, 1978-1980, by J.F.H. Thompson.

Compiled from G.M. Boone, unpublished map of the Pierce Pond quadrangle.

Compiled from E. Post, unpublished map of The Forks quadrangle.

Compiled from Boucot, A.J., and Heath, A.W., 1969, Geology of the Moose River and Roach River Synclinoria, northwestern Maine: Maine Geol. Survey Bull. 21. Limited field checking, 1980.

Compiled from Burroughs, W., 1979, Structure of the Dead River Formation in The Forks quadrangle, west-central Maine: unpub. MS thesis, Syracuse Univ.



Quadrangle Location

RECONNAISSANCE

BEDROCK GEOLOGY OF THE THE FORKS QUADRANGLE, MAINE

BY

WILLIAM BURROUGHS & ROBERT G. MARVINNEY

1981

Maine Geological Survey
DEPARTMENT OF CONSERVATION
Augusta, Maine 04333

Walter A. Anderson, State Geologist

OPEN FILE NO. 81-10